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Authorized by the Secretary of War
under the Supervision of the Surgeon-General
and the Council of National Defense

Primary Ophthalmic Surgery

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ELLEN GREENWOOD, M.D.

LIEUT.-COLONEL, MEDICAL CORPS, U. S. A.
FORMERLY LIEUT.-COLONEL, HARVARD SURGICAL UNIT WITH THE
FIRST MEDICAL CORPS, BRITISH EXPEDITIONARY FORCE

CHAPTER ON TRACHOMA, OTHER CONTAGIOUS
CONJUNCTIVAL DISEASES AND GAS CONJUNCTIVITIS

G. E. DE SCHWEINITZ, M.D.

LIEUT.-COLONEL, MEDICAL CORPS, U. S. A.

AND A

CHAPTER ON OCULAR MALINGERING

WALTER R. PARKER, M.D.

COLONEL, MEDICAL CORPS, U. S. A.

THIRD EDITION, THOROUGHLY REVISED

Illustrated



LEA & FEBIGER
PHILADELPHIA AND NEW YORK
1918

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MEDICAL WAR MANUAL No. 3

Authorized by the Secretary of War
and under the Supervision of the Surgeon-General
and the Council of National Defense

Military Ophthalmic Surgery

By ALLEN GREENWOOD, M.D.

LIEUT.-COLONEL, MEDICAL CORPS, U. S. A.

RECENTLY HONORARY LIEUT.-COLONEL, HARVARD SURGICAL UNIT WITH THE
ROYAL ARMY MEDICAL CORPS, BRITISH EXPEDITIONARY FORCE

INCLUDING A CHAPTER ON TRACHOMA, OTHER CONTAGIOUS
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PREFACE TO THE SECOND EDITION.

OWING to the absence of Lieut.-Colonel Greenwood on overseas duty, it has not been possible to secure the advantage of his revision of the section devoted to Military Ophthalmic Surgery. The Editor has added a few paragraphs, suggested by his experience abroad, distinguished by being placed within brackets, the most important of which are: Contusions Hypotony; Cartilage Prosthesis; Implantation after Remote Enucleation; Technic of Extraction of Intra-ocular Metallic Foreign Bodies in British "Eye Centers" in France.

The chapter on Trachoma has been revised by its author and an additional operative procedure, the one recommended by the trachoma experts of the Public Health Service, has been included.

The chapter on Examination of Malingerers has also been revised by its author and the tests for detecting simulated bilateral blindness have been added.

The authors express their high appreciation of the cordial reception which has been accorded to this small manual and trust the new edition may find favor among those for whom it was written.

LIEUT.-COLONEL DE SCHWEINITZ,

934261

Editor.
(iii)

PREFACE TO THE FIRST EDITION.

THIS hand-book has been compiled with the idea of providing, in condensed form, suggestions that may be helpful to medical officers who have to deal with the special ophthalmic problems which arise in the daily routine of active army medical work, especially in the dressing stations and hospitals throughout the war zone. The surgical methods described have proven their worth in hospitals in the British Army. The book is in no sense a complete treatise on ophthalmic surgery. For the multitude of ophthalmic operations and procedures which are common to civilian as well as army life a reference to the well-recognized text-books is suggested. The many operations, therefore, such as plastics, which will be required for later army and civilian reconstruction work, have not been included or described here.

Realizing the danger of trachoma and its spread in an army and understanding the tendency of recruits to malingering, the author appreciates to the fullest extent the great advantage of the chapters on Trachoma and Malingering so kindly con-

tributed by Drs. George E. de Schweinitz and Walter R. Parker, and extends his thanks accordingly. These chapters should be of especial value to the officers conducting cantonment examinations.

A. G.

WASHINGTON, 1917.

CONTENTS.

MILITARY OPHTHALMIC SURGERY	7
BY ALLEN GREENWOOD, M.D.	
TRACHOMA AND COMMON FORMS OF CONJUNCTIVITIS; GAS CONJUNCTIVITIS	61
BY G. E. DE SCHWEINITZ, M.D.	
EXAMINATION OF MALINGERERS	113
BY WALTER R. PARKER, M.D.	

MILITARY OPHTHALMIC SURGERY.

BY ALLEN GREENWOOD, M.D.,

LIEUT.-COLONEL, M. C., U. S. A.

No previous war has afforded an opportunity for the work of the ophthalmologist such as the present conflict presents. Therefore a chapter on military ophthalmic work will, of necessity, be largely a record of recent personal experiences. Many English ophthalmologists have had a much wider experience than the author, but during two seasons with the Harvard Surgical Unit, British Expeditionary Force, General Hospital No. 22, in France and consulting in the surrounding Base Hospitals an opportunity was afforded for observing and carrying out many varieties of ophthalmic technic.

Of the sick and wounded soldiers who come into Base Hospitals, about 10 per cent. require some immediate examination or treatment of the eyes or surrounding structures, or subsequent examination and treatment. Of the cases requiring later examination the largest percentage are

furnished by those where fundus or visual field examinations are asked for by the internist and the brain surgeon. Many soldiers who have severe devastating body injuries may subsequently show signs of an apparently minor eye injury which has been masked by the graver illness, but which later proves much more serious. It is important that the general surgeon, as well as the ophthalmologist, should be alive to the possibility of such occurrences. It is not a credit to the ophthalmic surgeons to have a soldier return to his home to convalesce following the loss of an arm or leg and have an iridocyclitis develop in one eye, as a result of an overlooked intra-ocular foreign body, and then to lose the other eye from sympathetic ophthalmitis. It is also important for the ophthalmic surgeon to carefully inspect and watch the good eye while treating an injured one and it is equally important that any wounded soldier should have available for the examination and treatment of his eye injuries an experienced ophthalmologist. For still graver and more complicated eye conditions there should be also available for him an ophthalmic surgeon of even wider experience as a consultant. In the majority of late discovered cases of intra-ocular foreign bodies the wound of entrance has healed and often cannot be found. The foreign body may have passed through the upper lid and the sclera into the vitreous, leaving no visible conjunctival wound,

and as the majority of men who enter the hospital have been wounded or exposed to wounds the ophthalmic surgeon should always be on the lookout for undiagnosed intra-ocular foreign bodies. Any soldier who complains of a recent blurring of vision of either eye should have a careful inspection and ophthalmoscopic examination under mydriasis, and if there is no circumcorneal injection, the pupil dilates readily and the vitreous appears clear, the presence of a foreign body is unlikely and the blurred vision due to some other cause, such as the amblyopia that is found in so-called cases of shell shock; but a suffused eye, with circumcorneal injection and signs of uveal congestion or beginning iridocyclitis, should be viewed with grave suspicion and be subject to a careful x-ray examination. Small fragments of aluminum may not show by the x-rays, but all other metallic bits will unless too minute. The author saw one patient where the track of a foreign body could be followed through the eye to its lodgment in the sclera above the macula. It was half a disk diameter in size, looked like silver, but on repeated trials gave no shadow with the x-rays. There was no reaction and no attempts were made toward its removal.

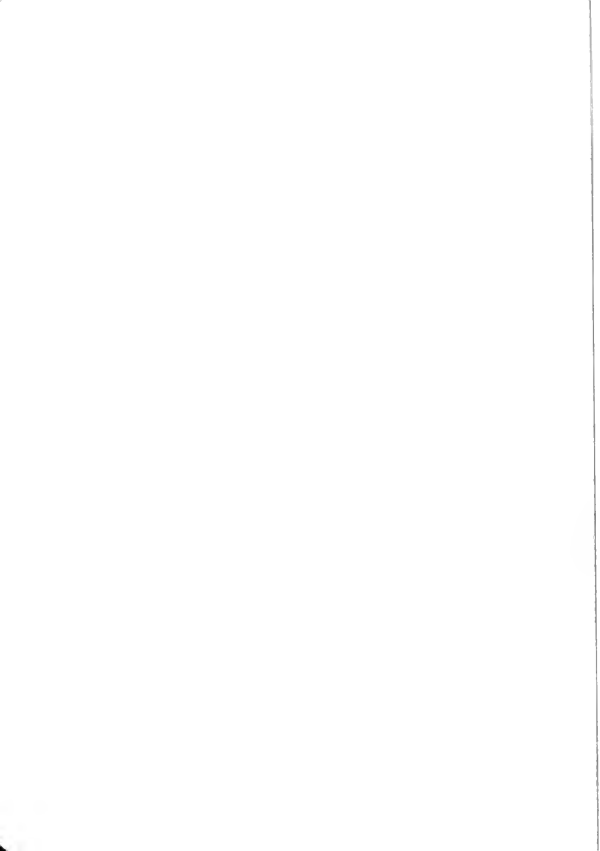
[It is important that every eye on which there is only a small patch of redness, which may conceal the entrance of a minute metallic foreign body, should be tested: "put up to the magnet," as the procedure is usually called.]

CONTUSIONS OF THE EYEBALL.

Contusions of the eyeball are among the common injuries seen and may vary from the slightest contusion, which results in a rapidly disappearing commotio retinae, to the severe hopeless case with a rupture of all the tunics of the eye, causing a gaping wound and extrusion of the globe contents. Between these two extremes will be found many grades, including single or multiple ruptures of the retina and choroid, with or without vitreous hemorrhage; tears of the iris sphincter with hyphemia and permanent loss of reaction; iridodialysis, partial and complete lens dislocations, even to subconjunctival luxations. These varying grades of contusions may be produced in many ways, such as direct blows on the anterior portion of the eye by spent or grazing missiles; sudden air expansions by nearby explosions or passing high-velocity bullets. Equatorial contusions are often produced by some portion of the surrounding bones being driven against the eye, or the vibratory effect of their being struck, the malar bone and the outer ridge of the orbit being particularly vulnerable. Posterior contusions may be produced by bullets, shrapnel balls and pieces of shell casing entering the posterior part of the orbit. One soldier was observed who had a bullet which had entered behind the left ear and finally penetrated the left eye, so that the point could be seen with the ophthalmoscope

PLATE I





(Plate I). For the large anterior ruptures, involving all the tunics, with extrusion of most of the globe contents, enucleation is necessary. For smaller anterior ruptures, with iris or ciliary prolapse, the treatment by conjunctival keratoplasty as described later is applicable. Treatment of the dislocated lenses is described in the paragraph devoted to traumatic cataracts. For other cases of contusion very little immediate special treatment is necessary. Rest and the application of compresses wrung out of ice-water are extremely useful in most cases for the first twenty-four hours or longer. One should always be on the watch in cases of partial lens dislocation for the secondary glaucoma which occasionally occurs, and for this reason the routine use of atropin is to be avoided. Unless the outer coat is ruptured bandaging is inadvisable. For the after-treatment of eyes that show vitreous blood-clot, massage, dionin and subconjunctival injections may help in the clearing, though often the blood-clots organize and a proliferating condition with subsequent shrinking results.

[CONTUSION HYPOTONY. — The statement that reduced intra-ocular tension is an important sign of perforating scleral wounds, and especially of valuable diagnostic import, where, for example, a small penetrating wound of the sclera is covered with tumid and swollen conjunctiva, must not be accepted unreservedly in view of many observa-

tions during the present war. In other words, reduced intra-ocular tension of the eyeball after injury and with only the slightest external manifestations does not necessarily mean wound or rupture of the globe. The contusion caused in the manner already described may create a hypotony of short or long duration and be associated with grave internal lesions—vitreous hemorrhage, vitreous infiltrations, rupture of the choroid, etc. The lowered tension may be due to increased rate of excretion of intra-ocular fluid through expanded channels of exit, to paresis of intra-ocular nerves, to rupture of the pectinate ligament or to detachment of the pars ciliaris retinae.]

WOUNDS OF THE EYEBALL.

Most of these wounds are produced by flying fragments of shell casing, bits of exploding hand grenades, unburned cordite or sand and gravel thrown into the eyes by the explosion of shells among the sandbags of the trench parapets. Burns of the lids, conjunctivæ and corneæ from liquid fire or nearby explosions are frequent. Bullets and shrapnel balls cause many of the most destructive injuries, especially the former.

Of the superficial wounds the majority consist of foreign bodies in the cornea, conjunctiva and sclera, and these are usually multiple. Many cases are seen in which the corneæ are peppered by fine

metallic dust which mostly remains on or in the cornea, though occasionally some may be driven with sufficient force to pass into the iris and lens, when they have to be treated as intra-ocular foreign bodies. The corneal foreign bodies can be removed by using a spud or broad cataract needle. A well-sharpened gouge is very useful, or the point of a Beer knife and much time and patience and a steady hand are required for these procedures. The point of the knife or gouge can be carefully worked beneath the foreign body and then by a slight lever movement the particle may be lifted out. Care must be taken not to push the particle through into the anterior chamber. Sometimes after a piece of steel, deeply embedded, has been loosened by the knife it can be drawn out by using the magnet. Soldiers are often brought in who have had one or both eyes peppered by unburnt cordite, leaving pasty yellowish masses embedded in the conjunctiva and cornea and in many cases in the iris and lens. The corneal masses may be largely removed, always exercising great care not to harm healthy tissue or penetrate the anterior chamber. The deeper and finer particles will gradually be thrown off and then the healing is usually prompt. For good-sized pieces embedded in the iris an iridectomy with irrigation of the anterior chamber is usually advisable and attempts may be made to pick off the pieces lying on the iris which

do not wash out with the irrigation. This particular class of eye cases calls for a judgment and skill only to be acquired by actual experience. The lenticular cases will be considered under the paragraph devoted to traumatic cataracts. For the prevention of ulceration following the removal of the foreign bodies one may use argyrol, White's ointment.

Hydrarg. chloridi corrosivi	gr. $\frac{1}{8}$.0081
Sodii chloridi	gr. v	.324
Petrolati	$\mathfrak{3v}$	155.52

nosophen ointment,

Nosophen	$\mathfrak{3ij}$	8.
Petrolati	$\mathfrak{3j}$	4.

or simple boric acid flushings. For the prevention of pain nothing serves the purpose better than 1 per cent. solution of holocain, and in most cases atropin is advisable. Many cases of simple abrasions of the corneæ are seen and most of these present some ulceration. Fortunately the ser-piginous type of ulcer is almost never seen, but hypopyon keratitis is common. These abrasions yield readily to the holocain, argyrol and atropin medication. If the abrasion is fairly deep and a large ulcerated area left this may be made to heal much more quickly by covering it with a conjunctival flap. For lid burns, ice-water compresses and boric ointment are best, and for conjunctival and

corneal burns the atropin and cocain alkaloid solution in castor oil. For finding small ulcers and abrasions and outlining them and to outline small corneal foreign bodies a solution of fluorescein is of great help and should always be at hand. The following is the formula for the solution:

Fluorescein	gr. viij	.123
Liq. potassæ	ʒss	2.
Aquæ dest.	ʒj	20.51

PENETRATING AND PERFORATING WOUNDS OF THE EYE.

Such wounds of the eye will test the skill of the ophthalmologist more than any other line of work done in the Army Hospital, and it is here that the greatest good can be accomplished in the prevention of blindness. The most difficult problems are those where a penetrating foreign body remains in the eye instead of perforating and passing into the orbit or beyond. The method of treating these penetrating wounds with the presence in the globe of one or more foreign particles depends largely on the size and shape of the pieces and whether or not magnetic. When the penetrating foreign body is quite large the eye is usually so badly lacerated and so much vitreous lost that any attempt to remove the large and jagged piece would result in still more laceration and loss, so that such eyes should be enucleated, or if in a condition of well-established panophthalmitis, eviscerated. On enu-

cleating these eyes it is usually found that the vitreous has been replaced by a large clot of blood and the extreme softness of such eyes with an absolute loss of vision constitutes an indication for early enucleation.

ENUCLEATION AND METALLIC OR GLASS PROSTHESIS.—This brings up the whole question of the proper methods of enucleation, and the author wishes to urge at this time that soldiers so injured should have an operation that will provide for them a socket for the wearing of an artificial eye that will give the best cosmetic results. A man who has given his eye for his country deserves certainly no less than this. If it is thought desirable to do a simple enucleation the least that the ophthalmic surgeon can do is to sew the four recti muscles together; but, better still, some form of implantation operation is a much more advisable procedure, and every soldier should have the benefit of such when possible. In the ordinary Base Hospital, where much infection is always present, an additional wound of the body to obtain fat for implantation in Ténon's capsule is contra-indicated. During the summer of 1916 the author had the opportunity of implanting over thirty glass globes where it was necessary to do an ordinary enucleation. A glass ball of at least 18 to 20 mm. diameter was always used, for the use of this large size rendered the possibility of extrusion of the globe less likely, and

this assertion was borne out by the fact that of those mentioned above as having been implanted all remained in. Gold balls are, of course, expensive, so that the implantation of the glass ball is surely the operation of election, and if carefully inserted with proper suturing of Ténon's capsule over the ball *always before* the suturing together of the muscles the likelihood of extrusion is largely eliminated. For the suturing of Ténon's capsule and the muscles as well as the conjunctiva, the author uses fairly fine twisted silk and the smallest full-curved needles. The silk thus buried beneath the conjunctiva is almost never seen again. In a previous article¹ the author has drawn attention to the great advantage of placing the sutures vertically in the conjunctiva in order to retain as long a palpable fissure as possible and thus avoid the dragging of the external canthus toward the center which results from a purse-string suture of the conjunctiva. By the use of the above-mentioned size of globes, following the method outlined, one is able to prevent *permanently* any sinking in of the upper lid such as will follow any other method. With a prosthesis in place and the lids closed there should be no difference in the appearance and level of the two upper lids. Any soldier who obtains

¹ Eucleation with Implantation of Hollow Gold or Glass Ball; A Plea for its More General Adoption, Archives of Ophthalmology, 1914, vol. xliii.

less than this after enucleation is not receiving the best results possible.

[**CARTILAGE PROSTHESIS.**—The implantation of glass or gold balls in the manner described in the previous paragraph does not meet the favor it has received from American surgeons among English and French ophthalmic surgeons. Mayard, for example, places himself on record that plastic surgeons are a unit as to the superiority of natural tissues in contrast to metallic or glass prosthesis. He is satisfied that transferred cartilage establishes fresh communications with the bloodvessels in its vicinity, and becomes fixed to the capsule in recent enucleations. Even if the cartilage after implantation is transformed into a species of fibrous tissue, it is believed by many surgeons that the cosmetic result is not disturbed. For the purpose of making cartilage implantation, generally the eighth rib is selected and the globe of cartilage removed with a trephine of such size as is suited to the conditions. The cartilage having been introduced within Ténon's capsule it is sutured to the inside or, if possible, the four straight muscles are attached by means of sutures to this cartilage sphere; the rest of the operation proceeds as has already been described. It has been stated that such grafts may be used even in the presence of septic eyes or septic sockets. Such use of cartilage implantation, that is, in the presence of septic sockets, the editor did not witness during

his service in France, and therefore cannot personally state whether the procedure would be wise or not.

In place of human cartilage it is the practice of some surgeons, notably Magitot, to use formalized cartilage taken from a calf- or lamb-rib. This is placed in formol, 10 per cent., for three days, and afterward freed from the formol by successive washings in sterile water. It is most important that there shall be a thorough removal of all traces of the formol before the cartilage is implanted, which can be shaped to any size that is required for the purpose of the implantation.

Terrien recommends a graft of cartilage, generally rib cartilage, 1.5 cm. in length, to which the tendons of the rectus muscles are sutured. In default of the graft prosthesis he greatly improved the appearances by using artificial stumps of hard ebonite shell in an envelope of soft India rubber, which was molded to the bottom of the conjunctival sac, or molds of wax were placed behind the artificial eye.

It is perfectly possible to improve badly formed sockets after primary enucleation by the implantation of a glass or gold ball into the orbit, an operation to which Webster Fox gave the name "implantation after remote enucleation of an eyeball." Should this operation be undertaken, for example, on the right orbit, after the eyelids are separated by means of a speculum, the conjunctiva is grasped up and in above the inner canthus and the tissues

are well pulled out. Next, a Beer knife or curved keratome is passed through the tissues somewhat obliquely and well down into the orbit and an opening made large enough for the insertion of the globe behind the tissues. This opening may be enlarged with curved scissors to the desired size. When ready a gold ball is inserted through the opening, which is closed with stitches, and over which a shell is placed, modelled after an artificial eye. The eyelids are then closed over this shell, which is left in place for twenty-four hours. The stitches are taken out on the third day. If the operation is to be performed on the left orbit the incision is made up and out, above the external rectus muscle, and the dissection carried out as previously described.

In place of the implantation of a glass or gold ball a cartilage sphere or graft may be used and stitched into place, with the result of much improving the appearances of the artificial eye, and preventing, or rather obviating, the unsightly or sunken appearance which only too often follows badly performed enucleations.]

In the torn eyes that present a panophthalmitis, with or without an orbital cellulitis, the ordinary enucleation should have substituted for it an evisceration. The simplest method of doing this is to make a circular cut just back of the ciliary body and in front of the recti muscle attachments. The

contents of the globe can then be scrubbed out with pledgets of gauze until nothing is left but the white sclera, which may then be cauterized lightly with crude carbolic acid. The dusting in of iodoform powder helps to lessen infection and subsequent purulent discharge. The pocket may then be filled with White's ointment. It is *necessary* to suture the conjunctiva or sclera, for the healing takes place very rapidly with the formation of the customary quadrilateral shaped stump which forms a fair substitute for the larger stump resulting from the glass-ball implantation. This is a very simple method of evisceration, and the after-results from the performance of a great many were invariably good. The principal advantage of this procedure lies in its not opening the optic nerve sheath and not disturbing the muscle attachments. For a torn and badly infected eye which often has associated an orbital cellulitis the above method commends itself by its simplicity, ease of execution and excellent results. In fact, healing after this method takes little longer than that after a simple enucleation and without special discomfort to the patient.

[Colonel Lister, of the B. E. F., has advocated and practised the enucleation of a septic eye with this modification, namely, that a fringe of sclera, about 10 mm. in width, is allowed to remain and surround the optic nerve entrance, avoiding, there-

fore, opening of the optic nerve sheath and the danger of conveying infection through this route.]

For the very large number of penetrating wounds showing by direct inspection, or the *x*-rays, the presence of one or more foreign bodies in the globe, the question of the method to be adopted for the early removal of the foreign particles must be considered. About two-fifths of these intra-ocular foreign bodies are magnetic and, if such be the case, removal of these by some form of magnet is usually the desirable method. Most of these magnetic particles lie in the vitreous chamber and some operators will prefer to attempt the removal of these by what is called the anterior and some by the posterior method, through a scleral incision, while some may remove them by way of the original wound. The choice of these three routes will depend largely on the size, shape and location of the foreign body.

If one is to use the anterior route, which is only applicable to fragments of small size, a giant magnet, or what the author calls "the arm magnet," of nearly equivalent strength, is necessary to give sufficient power to draw the foreign body carefully from the vitreous, through the zonule, and thence around the lens into the anterior chamber. When the foreign body has thus been drawn into the anterior chamber it may be removed through a corneal opening by further application of the large

magnet, or the hand magnet may be substituted for the large magnet in order to complete the operation.

In order to start the foreign body on its passage through the vitreous a repeated turning on and off of the magnet current may coax the particle forward, but the moment a bulging of the iris indicates

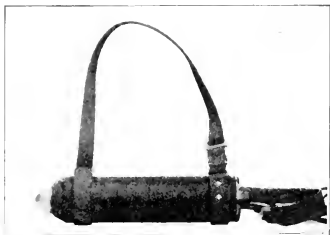


FIG. 1.—Arm magnet.

its presence in the posterior aqueous chamber the current must be turned off and the direction of the eye changed so that the pull of the magnet when the current is turned on may be parallel to the surface of the lens.

For larger foreign bodies in the vitreous, and for such operators as prefer it for the smaller also, the posterior route may be chosen, and for this class a very careful x-ray localization is especially essential. In operating a conjunctival flap is laid back

from over the selected point in the sclera, then a puncture is made in the latter and the rounded tip of the hand magnet applied to this opening, or the pointed tip may be passed into the vitreous to the



FIG. 2

vicinity of the foreign body, the current applied and the particle withdrawn. The incision in the sclera should always be made meridionally to avoid, so far as possible, cutting vessels, and may be held open by one of the little non-magnetic scleral

retractors devised for this purpose. When the tip of the hand magnet is applied to the opening in the sclera the foreign body may be slow in coming forward and patience and persistence in the application of the magnet may be rewarded by seeing



FIG. 3.—Illustrating pull from below.

the foreign body appear. There will also be a certain number of cases in which the foreign body and the wound of entrance are of considerable size and the latter open. Here it may be most advisable to draw the foreign body out through its wound of

entrance, especially in cases in which the lens has already been damaged. When using the magnet



FIG. 4.—Illustrating pull from above.

in this way care must be taken to turn the current on and approach the eye to the magnet slowly, so as to avoid too sudden a jump of the foreign body.

One would not like to see the whole of a patient's iris on the magnet tip. As complete a dilatation of the pupil as is possible is advisable before any magnet operation. The postoperative treatment and bandaging is the same as after any intra-ocular operation. The author's therapeutic preference being atropin, argyrol, iodoform and White's ointment, as indicated. The most favorable cases are those in which the magnetic foreign body lies anterior to the vitreous, either in the anterior chamber, iris or lens. Those in the anterior chamber can be readily removed through a small corneal incision by the use of the hand magnet. If it is entangled in the iris an effort should be made to disentangle it by careful use of the hand magnet or forceps, and if this is unsuccessful an iridectomy should be done and the foreign body brought out with its surrounding iris. If it is embedded in the anterior portion of the lens it may be possible to draw it out with the magnet into the anterior chamber, from which it can be removed. If it is deeply embedded it is advisable to wait until the lens becomes opaque, when both can be removed at the same time. A large particle anterior to the vitreous is more likely to be followed by permanent good results than a smaller posterior one.

[The technic almost universally employed by British ophthalmic surgeons in the B. E. F. for the

extraction of intra-ocular foreign bodies includes the use of a giant magnet, for example, of the Haab type, or one of equal drawing power, and a small magnet for the removal of the body after it has been drawn into the anterior chamber. As Whiting and Goulden record the general principles of the method adopted, they are these: The wound of entrance is disregarded from the point of view of extraction unless there is a large, unhealed wound in the cornea or sclera, which would be strongly suggestive of the presence of a large foreign body in the vitreous, which it would be hazardous to remove by any other path. Almost universally the foreign body is drawn forward through the suspensory ligament of the lens into the posterior chamber and next through the pupil into the anterior chamber. From the latter chamber, through a suitable corneal incision, the foreign body is removed by means of a small magnet. Referring to the x-rays and localization of the foreign bodies, so universally practised in our country, these authors state that its assistance is by no means essential to successful treatment, and if localization is likely to involve several hours' delay it should be omitted. The editor noted how much attention was paid to pain as a sign of the presence or not of the foreign body while watching the work in British hospitals in France, some magnets being supplied with a

special extension point for exploring the surface of the sclera in order to detect the spot of pain.

The foreign body having been drawn into the anterior chamber, if the eye is red and tender it is usually recommended that the final stage of the operation shall be done under the influence of general anesthesia. The corneal incision is made above, about 3 mm. below the limbus, the point of the knife being directed straight toward the foreign body and the incision completed without any lateral movement. So successfully is this done that very little aqueous is lost. The extension point of the magnet is next directed outside of the cornea immediately over the foreign body and the foreign body is gradually coaxed along the posterior surface of the cornea into the corneal incision, through which it is withdrawn. This method, briefly summarized, meets with the approval of Colonel Lister and is the outcome of a very great experience; but until the end-result of these magnet extractions are carefully tabulated it will be impossible to state with accuracy how they compare with those which follow careful localization and removal of the body by the scleral route. After the removal of foreign bodies a treatment with atropin ointment and iced compresses is advisable.]

In cases that present themselves with a posterior intra-ocular foreign body which is non-magnetic

there is usually very little that can be done. Occasionally one will see a case in which the vitreous is still clear and the particle can be easily seen with the ophthalmoscope. With a properly placed scleral cut the operator may with the electric ophthalmoscope see to guide a special pair of foreign body forceps within the eye, and in this way be able to seize and withdraw the particle. Occasionally, also, the x-rays may show the foreign body, by very careful localization, as lying in or on the sclera, and if so it may be possible to cut down directly onto and remove it. In the majority of these cases, however, enucleation becomes necessary, and in one eye removed by the author for multiple intra-ocular foreign bodies five were found in the vitreous, of which only one was magnetic. In some cases, particularly when a foreign body like aluminum is embedded and there is no reaction, it is much better surgery to leave the eye alone. It is a well-known fact that frequently an eye tolerates an encysted or embedded foreign body indefinitely, and therefore before removing such eyes the surgeon should give nature all the opportunity consistent with safety and comfort. The operator must never consider that having removed a foreign body from the eye his work is done, for it has in reality only begun. He is still confronted by the danger of severe iridocyclitis,

vitreous disturbances or retinal separation. For the two latter conditions very little can be done, but for the former much may be accomplished. The moment an iridocyclitis appears likely the atropin used should be increased in strength and instilled more frequently. The effect of atropin may be made more potent by the use of 5 to 10 per cent. solution of dionin, and this result can also be accomplished by the frequent use of hot fomentations.

Whenever available leeches should be applied to the temple, and the ophthalmic surgeon should never forget that the eyes he is treating are a part of the body and their welfare is strongly influenced by the general physical conditions. Soldiers who have been forced from their active life to complete rest are likely to become constipated, and this should be carefully looked out for. In the beginning of the iridocyclitis the author has placed great reliance on the use of calomel in two- or three-grain doses, followed by a saline. Inunctions of mercury have seemed to be of service in combating this condition, and for pain the use of fairly large doses of aspirin or salicylate of sodium. If in spite of treatment the iridocyclitis persists and the vision is lost it is necessary that the eye should be enucleated to prevent the possibility of sympathetic inflammation in the sound eye.

CONJUNCTIVAL KERATOPLASTY.—When the removed foreign body is of considerable size it often becomes necessary to adopt some method of sealing the wound to minimize the danger of infection, and such cases come under the same category as the penetrating wounds of the anterior portion of the eye, which occur in considerable numbers, without foreign-body inclusion. These wounds occur of all sizes and in all locations, from the small perforation near the limbus, with its protruding knuckle of iris, to the one that splits the cornea from limbus to limbus with iris prolapse at each end and a traumatic cataract presenting in the center. These wounds are mostly made as a result of a piece of shell casing striking some part of the bony ridge, which stops it, but not before some edge or corner of the flying missile has cut the eye; or a flying piece may pass across the front of the face, cutting lids and eyeball, to embed itself finally in the base of the nose or even in the other eye, making it imperative that everything possible be done to save the cut globe. Many cases are seen in which one eye has been torn out or into shreds and the other eye cut by the same missile. It is for such cases that the greatest skill of the ophthalmic surgeon is enlisted, and the author has come to have the greatest confidence in a well-performed conjunctival keratoplasty as giving by far the best results. It is advis-

able to make the conjunctival flap and have the sutures inserted before clearing up the wound or cutting off the iris prolapse, thus lessening the risk of vitreous loss. In removing the prolapsed iris it is always best to grasp the protruding bit and tease it out before cutting, so as to make the resulting coloboma larger than the wound and thus prevent adhesion to the edges. Where the lens is injured, so much as possible of the swollen substance should be removed by suction, irrigation, or both. When the wound is peripheral it is sufficient to cut the conjunctiva from the limbus along half the circumference of the cornea, with the center of the conjunctival cut opposite the corneal or limbus wound. After undermining the conjunctiva it will be found possible to draw it nearly to the middle of the cornea. The subconjunctival tissue, with its rich blood supply and abundant adhesive exudate, will seal the wound quickly and allow the anterior chamber to fill and atropin exert its influence. For corneal wounds more centrally placed or for wounds extending across the cornea a second curved cut in the conjunctiva, about 7 or 8 mm. from the circumcorneal one, is required so as to fashion a bridge of conjunctival tissue, which, by a suture above and below, can be drawn across the center of the cornea.

In three or four days the bridge can be sutured back onto its original position, leaving enough

subconjunctival tissue in the wound to seal it permanently and prevent staphyloma. By the above

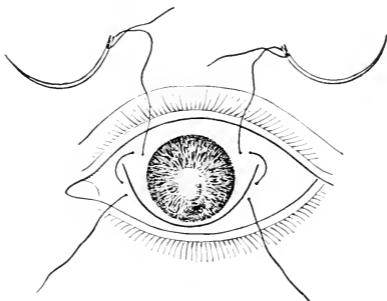


FIG. 5.—By passing the suture through a fold in flap and then through a fold above a firmer hold can be obtained and the anchoring hold should include episcleral tissue. (After Kuhnt.)

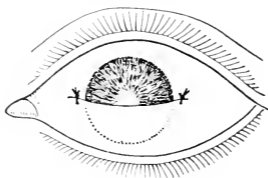


FIG. 6.—Flap in place (After Kuhnt.)

method it is possible to save many eyes that appear to be irreparably injured and frequently to save a

useful amount of vision; and the author would make a plea at this time that some such attempt

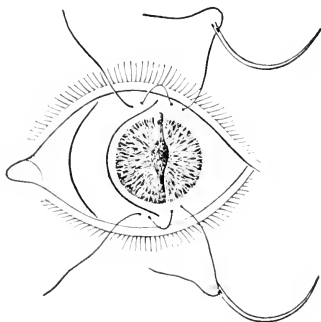


FIG. 7.—Bridge. (After Kuhnt.)

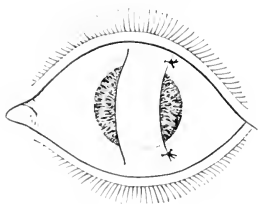


FIG. 8.—Bridge in place. (After Kuhnt.)

be made to save these apparently hopeless eyes, even if the cut passes through the ciliary body, for

if good healing takes place under the conjunctival flap, without any iridocyclitis resulting, the danger of sympathetic ophthalmitis is practically eliminated. If, after such an attempt at conservative surgery, there does appear infection and iridocyclitis, then the eye can be removed, with only a few days lost, and long before the danger of sympathetic ophthalmitis. The author saw no patients with this justly dreaded complication during his service and in no case did severe iridocyclitis follow a well-executed conjunctival keratoplasty, performed on eyes showing no signs of infection at the time of operation. Two things to be remembered are first, the advisability of getting flaps ready and the sutures in place before cutting off the prolapse, and thus possibly exposing the vitreous and causing loss of the latter by the manipulations and second, making sure that the entire wound is covered by the flap of conjunctiva. For cases where the wound extends a long way into the sclera, suturing of this may be necessary, followed by modified flaps to conform to the condition. Here a double flap may be crossed over the wound. Even in cases where there is a large prolapse of iris or ciliary body that has been left several days and is very adherent the above method is still applicable and far better than using the cautery which the author never approves of. Touching the edges of the scleral and conjunctival cuts with tincture of

iodin has been advocated and is a very useful procedure, and for the same purpose the author rubs in finely powdered iodoform.

TRAUMATIC CATARACTS.

The treatment of traumatic cataracts, seen so frequently, forms an important part of the work, and cases may be divided, for convenience of discussion, into those due to concussion and to those more frequently seen due to a perforating wound. The latter may occur with, or without, the presence of an intra-ocular foreign body and after the removal of the foreign body these cases may all be considered under the second of the above-mentioned divisions. Several factors should guide one in the treatment of cataracts due to non-perforating injuries. One of the principal guides being the tension of the eye, for if this be low an attempt to remove the opaque lens is inadvisable. If, however, the tension is increased, showing a glaucoma secondary to the swelling of the lens, operative interference is advisable rather than depending on myotics, unless the latter very speedily relieve the tension. The danger of iritic adhesions in such cases would ordinarily make one doubtful about using myotics, so that it has been the custom of the author to remove as much as possible of the swollen lens substance, leaving the remainder for future absorption under the use of atropin and dionin. Where

there is no pus tension and the opacity is not complete, it would be advisable to leave the lens alone unless the other eye has previously been lost; in which case operative interference may be demanded for the mental effect upon the patient produced by the restoration of vision. For these cases the ordinary combined extraction is advised without any extensive attempts to remove all of the cortical material, for these patients are mostly young and experience has shown that absorption of such remaining lens substance proceeds very rapidly. A dislocated lens should be removed if possible. When located in the anterior chamber the pupil should be contracted with eserine or pilocarpine prior to attempts at removal and at the time of removal a needle may be passed behind the lens to prevent its being pushed into the vitreous chamber. When the lens is located in the vitreous the ordinary cataract incision, preferably with a conjunctival flap and an iridectomy, may permit the operator to lift out the lens by using the vectis, with only a slight loss of vitreous. Where there is only a partial dislocation it would be better surgery to let the lens alone unless the advent of complications demands its removal. In the rare cases where the sclera has ruptured and the lens has been forced out of the wound and under the conjunctiva it is better to remove it and bring the scleral wound together either by scleral stitches or by anchoring

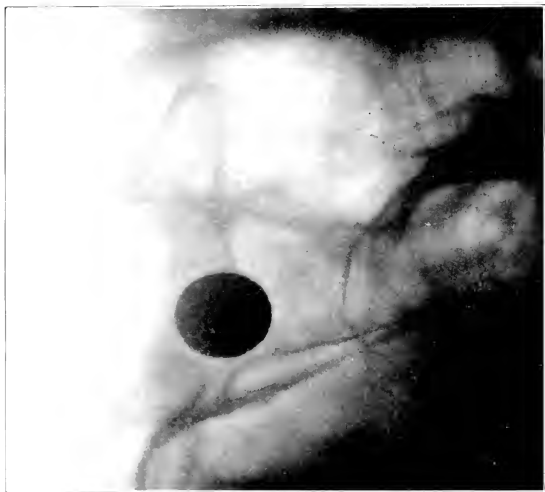
the conjunctiva in such a way as to pull the wound together. This seems much better than leaving the lens until the scleral wound has healed. In the cases of cataracts due to perforating injuries, as a rule the treatment may be carried out at the time of the reparative work on the injured eye, especially if the lens is considerably broken up. For operating on eyes showing a swollen traumatic cataract the following procedure is advisable: Through the original wound if it still be open or through a corneal incision made with the keratome or Graefe knife the tip of the suction apparatus can be placed inside and a goodly portion of the swollen lens substance withdrawn. In doing this one must make sure that the anterior capsule is well open and retracted. Otherwise the suction apparatus will not take up the lens substance. The removal of the middle of the anterior lens capsule by means of capsule forceps is advised. The remaining portions of the lens substance can be washed out with the irrigator or the irrigator may be used for the whole operation by those not wishing to use the suction apparatus. In some cases it may be possible to remove the greater portion of the lens substance by massage of the cornea, though the author much prefers one of the foregoing methods. After the removal of the lens substance the iris, which has been displaced or extruded during the procedure, must be put back

either with the stream of water from the irrigator or a repositor, and if it does not go back readily and smoothly an iridectomy should be performed. Atropin both before and after the operation will help to prevent adhesions between the iris and the strands of lens capsule. Where a very minute fragment has passed through the lens and been removed by the magnet either by the anterior or the posterior method the lens injury may safely be disregarded, for in some cases the lenticular opacity will be permanently confined to the part of the lens through which the fragment has passed.

PENETRATING WOUNDS OF THE ORBIT.

Here again the treatment will depend largely on the presence or absence of a foreign body. Many of the bullet wounds involving the orbit are through and through, and several were seen by the author where the bullet had passed through the apex of both orbits from side to side, cutting the optic nerves. Except for the direct injury produced and the consequent filling of the orbit with blood such through-and-through bullet wounds are usually not attended by complications in healing, unless too great a degree of proptosis results. This may also be true of the round lead shrapnel bullet, which may enter the orbit without causing much damage and be removed, leaving the important orbital structures intact (Plate II). All this, however, is not

PLATE II



X-ray of shrapnel ball which entered the orbit between the eyeball and the lacrymal bone. It passed just behind the eyeball and was removed, leaving the latter uninjured.



PLATE III



X-ray of piece of brass shell timer located in right frontal sinus, having passed through the left eye and left frontal sinus.

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true of other forms of missile, especially the jagged pieces of shell casing which are very likely to produce an orbital cellulitis that may be caused by the *Bacillus aërogenes capsulatus*. The author has seen 5 cases of such gas-bacillus infection of the orbit, with one death. Removal of the offending foreign substance from the orbit and free drainage, with the use in the most severe cases of Carrell's tubes, will usually take care of orbital cellulitis.

Careful localization by means of the *x*-ray is of first importance before making attempts to remove intra-ocular foreign bodies, to determine whether they have passed outside of the orbit, or may be intra-orbital. In many cases it will be found that they have passed into the brain cavity, requiring a craniectomy for their removal. For such cases a specially devised brain tip for the arm magnet may be of signal service. Such a brain tip has been previously suggested by the author for the Lancaster arm magnet and is about the size and shape of the ordinary blackboard crayon. Foreign bodies which have passed through the orbit may also be located in the frontal sinus or ethmoid and after *x*-ray localization be removed (Plate III). Experience has shown that if such foreign bodies have passed through both the orbit and ethmoid into the brain cavity there usually results a fatal meningitis. Two of the author's cases, however, where the foreign body had driven the superior orbital plate

upward into the brain cavity were followed by recovery. In the case of small fragments that have passed into the apex of the orbit where attempts at removal might endanger the muscles and nerves it is wiser to refrain from interference unless subsequently an orbital cellulitis develops, though it is not usual for small fragments to penetrate so deeply. One complication deserves especial mention here, for prompt treatment may result in saving an eye, or possibly an only eye. This refers to the neuro-paralytic corneal disturbances resulting from an injury to the orbital nerves and the corneal disturbances due to exposure where an orbital hemorrhage or injury has caused excessive proptosis. These two conditions usually occur together and there should be added to them at this time the cases of corneal exposures from lagophthalmos due to an injury that has cut the facial nerve. The moment the cornea shows signs of loss of luster or beginning ulceration, and in selected cases even before the signs appear, the outer two-thirds of the lids should be sutured together. As the cases may be of long duration, especially those with lagophthalmus, it is best to pare the outer two-thirds of both lid edges, avoiding the lashes, prior to suturing, so that they may remain united as long as desired. This procedure leaves a small lid aperture through which the eye condition may be observed and treated and the patient see. If considerable ulcer-

ation of the cornea has already appeared at the usual position, just above the lower limbus, better and quicker healing for this may be brought about by covering the lower half of the cornea with a conjunctival flap after curetting the ulcer and rubbing in iodoform or tincture of iodine. Subsequent treatment depends on conditions as they arise. The following case illustrates the above very well.

Sergeant H. Entered the hospital after having been hit on the left side of the face by a large piece of shell which fractured both the upper and lower jaw, with multiple cuts in the parotid region extending from the zygoma down to the angle of the mandible. There was a good deal of loss of tissue in this region and the ear was badly torn. The injury was three days old and as a result of a complete lagophthalmus and exposure of the eye there was a deep corneal ulcer involving the lower quarter of the cornea. There was a hypopyon occupying the lower third of the anterior chamber which shifted on the patient lying on his side. The patient was in a semiconscious condition, but it was thought best to make an attempt to save the eye. The usual conjunctival flap for such a condition was prepared and the outer two-thirds of the lid edges were pared off, then the ulcer scraped, the anterior chamber opened and the pus allowed to escape, iodoform was rubbed in and the conjunctival flap drawn up over the lower half of the cornea. The

prepared portion of the lids were then sutured together, White's ointment applied and the eye bandaged. Twice daily after this the conjunctival sac was washed out through the aperture left between the lids near the inner canthus and atropin and argyrol instilled. After a few days of this the conjunctival flap pulled back, showing a perfect healing of the corneal ulcer. The patient left the hospital about six weeks later with the lids still held together and with excellent vision through the unsutured portion, the pupil fully dilated with atropin and the cornea showing a slight hazy cicatrix where the former ulcer had been. This experience was repeated a number of times, so that this procedure can certainly be recommended in these desperate cases.

[The danger of injudicious exploration of the orbital tissues and the tolerance by the orbit of foreign bodies have been described. Sometimes deeply situated foreign bodies may be secured, after x-ray localization, by resection of the temporal wall of the orbit: in one case examined by the editor the body—a piece of shrapnel—being situated just at the apex of the orbit in contact with the optic nerve.]

WOUNDS OF THE EYELIDS

In this war severe wounds of the face have been extremely common and many of these have involved the eyelids, with or without some of the ocular wounds described above. In some cases the lids are actually torn away and completely destroyed, so that subsequently careful plastic surgery becomes necessary. Pedicled flaps may be used provided there has not been a large destruction of surrounding skin tissue. Otherwise, Thiersch grafts may be employed. No definite rules of procedure can be laid down because the cases vary so much and each individual case must be treated according to the conditions and along the lines that have proved best for the individual operator. Cuts and tears of the lids where the loss of tissue is slight or absent should be carefully sutured as *early* as possible. The greatest pains must be taken to see that the conjunctival portion is first accurately sutured and that the line of the lashes be restored before suturing the skin wound. This is no less true when the eye itself is destroyed, for in such a case the good appearance of an artificial eye may depend on the accuracy of lid suturing. When the cuts are multiple the usual condition, and especially through the inner canthus, a severe test is put on the operator's skill and patience. For the conjunctival portion of the cut, fine silk is the best suturing

material, and this is also used for the skin, though one may substitute horsehair, silkworm gut, or catgut. When the cut extends into skin beyond the lids silkworm gut affords the best material. Owing to the fact that many of these lid cases have been dealt with as open wounds until their arrival at the Base Hospital it is necessary that the wound edges be freshened before suturing. If subsequent infection takes place and the wound opens, plastic surgery becomes necessary later. It is not the purpose in this chapter to enter into a description of plastic work for restoration of lids and sockets, though of such work there will be plenty after the war. The present appeal is for the earliest possible suturing of lid wounds.

PROPHYLAXIS.

It is well to consider at this time the best method of preventing some of these severe eye injuries, and the author had worked out a tentative plan for a steel eye shield to be fastened to the soldier's helmet. On taking up the question with some of the authorities in Washington it was found that Colonel W. H. Wilmer had, at the request of the Ordnance Department, devised a shield along similar lines and one that left very little, if anything, to be desired toward accomplishing its purpose. The author's shield had two stenopeic slits, one hori-

zontal and one vertical, while Dr. Wilmer's has a single horizontal stenopeic slit in front of each eye which allows for good vision, greatly enhances the strength of the shield and is by far the best. By extending the shield on each side it can be made to cover the temple region, thus including the outer ridge of the orbit and the malar bone. Such a shield if fastened to the helmet so that it can be swung up out of the way when not in use would, if the soldiers could be induced to wear them, lessen to a very great extent the number of eye injuries. A full description of Colonel Wilmer's ingenious device will probably be written by him. In devising such shields with a single stenopeic slit, the closer it can be brought to the eyes the better. The question of whether it is advisable to make the eye shield tight enough to keep out lachrymatory gases by careful padding and placing some transparent material behind the opening can only be decided by actual experience. Such a tight shield might cause a steaming of the transparent material and prevent its use. It might possibly be more advisable to have the gas mask entirely separate from the shield and make no attempts to keep the latter air-tight.

**EYE CONDITIONS THAT ARE AN EXPRESSION OR
DIAGNOSTIC SIGN OF DISEASE OR INJURIES
ELSEWHERE.**

Retinal and optic nerve alterations may be found in the so-called trench nephritis. To see these signs at their height one must examine the nephritis cases as soon as they enter the hospital, for the slight optic neuritis and retinal edema seen in at least 75 per cent. of the severe cases is very ephemeral and subsides as rapidly as the general edema. Rarely hemorrhages may be seen but no sign of vessel or retinal degeneration. One of the most important services of the ophthalmic surgeon lies in his examination for eye signs in all cranial injuries whether they are simple concussions, furrow wounds, fractures or penetrating wounds, and a load of responsibility rests upon him, for the general surgeon frequently bases his decision as to operating on the report of his ophthalmic confrère. Most of the severe local head blows made by glancing bullets or shrapnel balls (the so-called furrow wounds), or an impinging but not penetrating piece of shell casing, which have resulted in splintering of the inner table, or the brain destruction which may occur without any splintering whatever, will sooner or later give rise to increased intracranial pressure, the first sign of which is a rapidly developing disk-edema which quickly increases to a choking of the disk. In these cases

the condition from the start is of the choked disk or intracranial pressure type, where the swelling is confined almost wholly to the nerve head even when it is raised several diopters above the surrounding retina. This type of optic nerve change can thus be differentiated from the inflammatory type which is seen in the cases that develop meningitis. Here besides the swollen nerve head there is an extension of inflammatory disturbance for some distance out into the retinal tissue, with frequently hemorrhages and exudates. Thus it is possible in some cases to differentiate between intracranial pressure and meningitis even in the early stages of these conditions. When the nerve change is due to increased intracranial pressure a trephining over the injured brain area, which allows for the removal of an extradural or intradural blood-clot or disorganized brain substance, results in its rapid disappearance. A recrudescence of these nerve conditions would indicate a return of the intracranial pressure, demanding further interference. When, however, the inflammatory neuritis type is seen it usually indicates a purulent meningitis for which little can be done. For the injuries of the back of the head besides a fundus inspection there should be a careful testing of the visual fields. Such an examination will reveal many cases of varying types of hemianopsia from the complete homonymous hemianopsia to hemian-

opic scotomata and quadrant defects. Frequently it will be found in the long furrow wounds across the occipital region that the brain lesion as shown by the hemianopsia is on the side not indicated by the most severe portion of the scalp injury. For a treatise on the very careful working out of such fields the reader is referred to an excellent one by Holmes and Lister (*Proceedings Royal Society Medicine*, June, 1916). Some of the hemianopsias will recover following operative interference, but some will not. When the hemianopsia is not accompanied by optic nerve changes and there are no other indications for operation and the bone uninjured, operation is not advised. Various paralyzes of the third and sixth ocular nerves may result from basal fractures and are interesting from the stand-point of localization, but have no special bearing on the question of prognosis or treatment.

[Almost always a papillary swelling appearing soon after a cranial injury indicates a developing choked disk. Disk changes occurring at a later period may be papillo-edemas (choked disks) caused, for example, by a cyst, or papillitis (optic neuritis) in association with brain abscess in meningitis. Bilateral choked disks which arise weeks and months after cranial injury are of grave import in that they indicate a serious intracranial lesion which has escaped notice. Hence the impor-

tance, as has been pointed out, of frequent ophthalmoscopic examination after all cranial injuries.]

PSYCHONEUROSES.

It is not within the scope of this book to enter into a lengthy discussion as to the various forms of psychoneuroses which often accompany the so-called shell shock. Many cases of amblyopia are observed and some of them have been proved to be similar to the hysterical amblyopia seen in civil life. Some soldiers with night-blindness come under the same category, though several seen showed typical retinitis pigmentosa and were evidently affected before entering the service.

REFRACTION.

Each Base Hospital should have a trial case and frames so that emergency refraction work can be done for officers and such of the personnel as may require it. It is, however, not the purpose of this book to go into the subject of refraction. When a Special Hospital is reasonably near the Base Hospital such work can be better done there. A full equipment is necessary in each Base Hospital for performing the various tests for detecting malingerers. The description of such tests by Colonel Walter R. Parker is given in Section III, and is very complete.

From my experience and observations while doing the eye work for Base Hospitals aggregating nearly ten thousand beds I have become firmly convinced that with the large groups of Base Hospitals handy to them there should be established a Special Hospital so that men with seriously wounded eyes might have the care that is given to such cases in the many civilian Special Hospitals found so necessary in the industrial centers in this country. The more remote Base Hospitals are from the home country the greater the need of a Special Hospital in the war zone, *as much for the beginning of reconstruction work* as for the acute cases. Men in Field Hospitals whose principal injury is obviously a severe one of the eye could be tagged and sent directly to the Special Hospital, while men in Base Hospitals requiring treatment best afforded by the Special Hospital could be transferred in a few hours, as shown by actual experience. Such a Special Hospital could have a much more extensive equipment than the average Base Hospital. There should be an operating building with at least two operating rooms, one for the infected cases and one for the non-infected. In the latter various types and strengths of magnets should be installed. An x-ray room should be provided and placed in charge of an Officer thoroughly familiar with intra-ocular foreign-body localization. The x-ray operator in the average Base Hospital has not this

familiarity and as a rule has not the time to develop such. One American who has recently published nearly one thousand foreign-body records is recognized as one of the finest röntgenologists and foreign-body localization experts in the world, and it would certainly seem wasteful to ask such a man to take care of the few cases requiring such experience that would come to the average Base Hospital when in a Special Hospital so much greater use might be made of such unusual ability. A dark room in the operating building is necessary for fundus and retinoscopic work and some of the wards should be arranged so that they could be darkened. A long vision room with trial cases and all the equipment necessary for the best refraction work should be provided and one or more expert opticians with all the tools and supplies required to grind and cut out lenses and adjust frames. A good supply of already cut round cylinders and spherocylinders could be carried and the correct axes be obtained by simply turning them in the frames. Lastly, but by no means least, the nurses in such a hospital could be chosen from those having special training in some of the Eye and Ear Hospitals. Such a hospital might be made part of a Special Hospital for head, ear, face, and jaw injuries, there being, of course, great need for early reconstruction work along all these lines. Some such scheme for the employment of special men has

for some time been followed by the Continental Army Medical Departments and it is becoming more evident every day that the best reconstruction work begins as soon as possible after a soldier has been wounded, and in no line of surgery is early special work more necessary and productive of good results than ophthalmic surgery.

It has been impossible in a condensed account of personal experiences like this to cover in detail all military eye work, but it is the hope of the author that helpful hints may be found in it for the ophthalmic surgeons who go fresh from civilian practice into Army Hospital work, and that they may be stimulated by it to careful attempts to do conservative eye surgery for the soldiers who give so much. It is also hoped that, from the above, a realization of how frequently severe multiple eye injuries occur in trench warfare and how important the saving of sight is, both to the soldier and the country, may stimulate men of wide ophthalmic experience to serve, and the army heads entrusted with the lives and sight of soldiers may be induced to see that such experienced men are made available for the wounded. The niceties of skill and judgment necessary to handle the multitude of severe cases can, however, only be acquired by actual experience, for the author cannot agree with those who consider that military ophthalmology differs from civilian only in degree but not in kind.

How many civilian ophthalmic surgeons, if any, have treated gas-bacillus infections of the orbit and face, and how many have treated eye and orbital injuries due to high-velocity bullets? In reality there are many eye conditions seen which are entirely new even to men of large experience in industrial accidents.

The following list of instruments necessary for a Base Hospital is here included:

ARMY CASE OF EYE INSTRUMENTS. MODEL OF 1917.
(In Mahogany Case.)

	Quantity.
Curette, chalazion (Mayhoefer), medium	1
Cystotome (Graefe)	1
Canaliculus knife (Bowman), flexible shank	2
Forceps, advancement (Reese's)	1
Forceps, cilia, plain	1
Forceps, chalazion (Lambert's)	1
Forceps, entropion (Desmarres)	1
Forceps, fixation with catch	2
Forceps, iris, angular, mouse-toothed	2
Forceps, trachoma (Noyes's), 1 up and 1 down	2
Forceps, trachoma (Prince's)	1
Gouge, sharp-pointed, V-shaped	1
Iris hook, sharp (Tyrell's)	1
Iris scissors, full curved	2
Knives, cataract (Graef's), assorted sizes	3
Irrigator, anterior chamber	1
Knives, scalpel type, medium size	3
Knives, needle (Knapp's), medium size	3
Keratome, angular (Jaeger's), medium size	3
Lens, spoon, metal (Graefe's)	1
Lens, spoon, metal (Daviel's)	1
Lens, condensing, 2 inches broad, hard-rubber ring	1
Lid plate, hard rubber (Jaeger's)	1

	Quantity.
Needle-holding forceps (Stevens's)	2
Lens, spoon, wire loupe	1
Needles, paracentesis	1
Needles, full curved, plain eye, cutting edge	12
Needles, half curved, plain eye, cutting edge, assorted.	12
Ophthalmoscope (Loring's)	1
Probes, lachrymal (Theobold's), double-ended (set)	1
Retinoscope	1

AUXILIARY CASE.

Cautery handle.
 Cautery tips (corneal set).
 Lachrymal (canaliculus) dilator.
 Fixation forceps (without catch).
 Iris forceps (curved 2, straight 1).
 Capsule forceps.
 Trachoma forceps (Knapp's).
 Advancement forceps (Prince's).
 Entropion forceps (right and left angular).
 Lid elevator, 1 additional.
 Keratomes, straight.
 Knife, cataract (Graefe's), 3 additional.
 Knife (Beer's).
 Knife, scalpel type, 3 additional.
 Knife, needle (Hays-Ziegler).
 Needle holder.
 Additional needles, 2 dozen curved.
 Scissors, straight, sharp-pointed.
 Scissors, straight, dull-pointed.
 Scissors, half curved.
 1 speculum, additional (Weeks's).
 1 spud, protecting handle.
 Tenotomy hook (Smith's).
 Tonotomy hook (Graefe's) additional.
 Trephine (Elliot's).

ADDITIONAL EQUIPMENT NOT TO GO IN CASE.

- 12 soft-rubber ear syringes.
- 1 DeZeng box, with electric ophthalmoscope and retinoscope.
- 1 hand perimeter (Schweigger's), with 12 dozen charts.
- 2 magnets (Lancaster models), Thomas Gleeson, Boston.
- 2 pocket flashlights, with extra batteries.
- 1 corneal loupe (Berger's).
- 3 irrigators (New York Eye and Ear Pattern).
- Suction apparatus.
- Glass balls (18, 20, 22 mm., 12 each, lead free).
- Projection lamp for illumination in eye operating.
- Apparatus for localizing foreign bodies (Sweet).
- Holgrem's stick of colored worsteds.
- Tonometer (Schiotz's).
- Treatment case.
- Set of non-magnetic instruments.
- Instrument rack.
- Undines, 12.
- 2 solution bottles.
- 2 condensing lenses.
- 1 wall cabinet.



APPENDIX.

INDICATIONS FOR ENUCLEATION.¹

1. AN eye with a wound so situated as to involve the ciliary region, and so extensive as to destroy sight immediately or to make its ultimate destruction by inflammation of the iris and ciliary body reasonably certain.

2. An eye with a wound in this region already complicated by severe inflammation of the iris or ciliary body, even if sight is not destroyed; or an eye containing a foreign body which judicious efforts have failed to extract, and in which severe iritis is present, even if sight is not destroyed.

3. An eye the vision of which has been destroyed by plastic iridocyclitis, or one which has atrophied or shrunk, provided there are tenderness on pressure in the ciliary region and attacks of recurring irritation; or without waiting for signs of irritation.

4. An eye the sight of which has been destroyed, even though sympathetic inflammation has begun

¹From Manual of Ophthalmology, prepared by the Sub-section of Ophthalmology, Section of Surgery of the Head, Office of Surgeon-General, War Department, Washington.

in the sympathizing eye, in the hope of removing a source of irritation, and thus rendering treatment to the second eye more effectual.

5. An eye in which the wound has involved the cornea, iris, or ciliary region, either with or without injury to the lens, and in which persistent sympathetic irritation in the fellow eye has occurred, or in which there have been repeated relapses of sympathetic irritation.

6. An eye either primarily lost by injury or in a state of atrophy associated with signs of sympathetic irritation in the fellow eye.

INDICATIONS FOR EVISCERATION.

Evisceration should be substituted for enucleation:

1. When there is an infected eye with infection of the surrounding orbital tissues.

2. When there is a panophthalmitis following a perforating wound and the wound is still open and extruding infected material.

3. When the eye has been partly eviscerated by a passing bullet or fragment of shell.

4. When the patient is *in extremis* and a hopelessly torn eye must be treated with the greatest speed.

TRACHOMA AND COMMON FORMS OF CONJUNCTIVITIS; GAS CONJUNC- TIVITIS.

BY G. E. DE SCHWEINITZ, M.D.,

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HISTORY.—Trachoma is of ancient lineage. It is referred to in the *Ebers Papyrus*, the oldest medical book on record, written during the height of Egyptian civilization, therefore 1553 B.C., and more than one thousand years before Hippocrates flourished. Its description finds place in the pseudo-Hippocratic manuscripts (460 B.C.), and it was well depicted by Celsus in the time of Christ. Probably known to the ancient civilization of India and China, it certainly was familiar to the Greeks and Romans, and, as Boldt points out, is mentioned in the *Comedies* of Aristophanes (431 B.C.). Although trachoma existed in Egypt in early days, its widespread evil influence in this country is not definitely described until about the middle of the fifteenth century, and one hundred years later the affection had become pandemic, and this hold it has retained until the present day. Originally known as "ophthalmia" or "lippitudo," the word trachoma appears first in the writings of Pedannius

Dioscordes (60 A.D.). The term "Egyptian ophthalmia" came into existence after Napoleon's Egyptian campaign (1798), from which time, to quote Boldt, there dates a new era, pregnant with evil, for the Continent of Europe, although the disease in this area had been endemic from time immemorial. At what period trachoma invaded our own country is unknown. It may have been introduced during Colonial days, or in the tide of immigration at a later period.

DISTRIBUTION.—The dissemination of trachoma in Europe became noteworthy after the return of Napoleon's soldiers from Egypt, inasmuch as 75 per cent. of them had been infected. They came repeatedly in contact with each other and with the civil population, and thus spread the disease, often in epidemic virulence. In the English Army in 1818 more than 5000 soldiers practically lost their sight by reason of this disease; in 1813-1819, in the Prussian Armies, 20,000 to 30,000 were placed on the invalid list because of it; and in the Russian Armies from 1816-1839, 76,811 men were found to be its subjects; while in Belgium in 1840 one out of five men in the army was attacked (Fuchs). Although in our time such epidemics have almost ceased, with few exceptions, for instance, in Russia, and although in foreign army life the proportion of trachoma has greatly lessened, the menace of this disease remains in these circum-

stances most conspicuous. Puscaria, quoted by Duane, reports in 1900 that almost 16 per cent. of the Roumanian Army were affected.

In the present war several epidemics, controlled with difficulty, have been recorded, and trachoma among alien laborers at the Western front has at times presented the British with a serious problem, which, however, has been admirably solved. Thus Major T. F. Cunningham and Captain J. Wharton, of the British Expeditionary Force, report that 19 per cent. of the Egyptians brought into France had active trachoma and 9 per cent. of the Chinese. The infected cases were isolated and the disease was not transmitted to the troops or civilian population.

In the early portion of the nineteenth century trachoma found in civil life a favorable soil for its dissemination in jails, asylums and wherever inhabitants of the poorer classes dwelt together in close contact, and at this time in many pauper schools every inmate was affected. The acute course which the disease manifested at this period of its history was doubtless due to mixed infection, and such epidemics have in great measure disappeared. Nevertheless, trachoma remains *endemic* in many lands; it is, indeed, a *world disease*. It is most frequent in Arabia and Palestine, and in Egypt it is generalized, fully 95 per cent. of the population being affected (MacCallan). Trachoma

is endemic in Syria, Persia, Central Asia, China and Japan. Exceedingly prevalent in Eastern Europe, especially in Gallipoli, Poland, Lithuania, Russia, Hungary and certain districts in Prussia, it is noteworthy that Jews of inferior social grade are prone to be affected. It is frequent among Italians of the lower orders, especially in the south of Italy. In England "trachoma is an alien disease, imported by aliens, propagated by aliens and handed on to the native population by aliens" (Parsons); in Ireland it is common among the poorer classes.

The menace of trachoma on our own shores is one of the serious problems of our Immigration Officers. Thus the number of aliens entering the port of New York during the fiscal year 1908-1909 was 724,757, among whom 1083 cases of trachoma were discovered. Aliens to the number of 481,270 were inspected and certified at all ports in the United States, its dependencies and in Canada during 1916, among whom 920 trachoma cases were discovered.¹ It is common among native Americans in certain portions of our own country, moreover, in severe and destructive manifestation, especially in definite areas in Illinois, in the mountainous regions of Kentucky and West Virginia, and is particularly noteworthy, according to the

¹ There has been a marked restriction of immigration during the past four years, owing to the European War.

admirable researches of Dr. Stucky and of Dr. John McMullen, of the United States Public Health Service, in the neighborhood of the junction of Kentucky, Tennessee and the Virginias.¹ In States where high winds prevail and there is much irritating alkaline dust, *e. g.*, in Oklahoma, Arkansas, Texas, Arizona and New Mexico, trachoma is very prevalent. To the prevalence of trachoma among the Indians of our country much attention has been paid, with encouraging results. The annual reports of the Commissioner of Indian Affairs since 1911 show an estimated percentage of trachoma never higher than 20.44 per cent. This percentage has gradually been reduced until in the last annual report the percentage of estimated trachoma is 17 per cent., based on a population of 194,824.

A certain racial predisposition to trachoma has been maintained, the Mongolian race being especially liable; but throughout Asia the disease is no respecter of race, the Aryan, Semitic and Mongolian suffering with equal and terrible frequency. Although the negro may have a certain resistance to trachoma, his exemption, at one time insisted upon by Burnett and others, is certainly not correct, as is shown by Minor and White, and the author has observed a number of cases in a large

¹ During the fiscal year 1915-16 the daily attendance at five trachoma hospitals established by the Public Health Service, three in Kentucky and one each in Virginia and West Virginia, was 19,536.

experience in the Philadelphia General Hospital, although he cannot be sure that these negroes were of pure blood.

A climatic predisposition is more than doubtful, although it has been found that dwellers in certain regions of the earth where the climate is damp are readily affected. While it has been maintained that an altitude of more than a thousand feet confers a comparative immunity from the disease and facilitates its cure, and while this appears to be true in Switzerland and the Tyrol, certainly in our own country no such influence of altitude is evident. D. W. White has found and studied the disease 8000 feet above sea level.

SITUATION OF THE LESIONS OF THE DISEASE.—The thin skin of the eyelids is loosely attached to the underlying structures by a delicate connective tissue which is free from fat, hence the ease with which they are wrinkled and shifted. To give the lids shape and support the so-called *tarsal cartilages* are supplied. These structures, however, do not contain cartilage but are composed of a firm connective tissue. The *tarsus* of the upper lid is larger and higher than that of the lower lid. The convex border of each tarsus is attached; its other border is free. Upon the anterior surface of the tarsus lie the fibers of the orbicularis muscle; its posterior surface is covered with conjunctiva. The tendon of the levator palpebræ superioris is attached to

the anterior surface of the tarsus of the upper lid. To each tarsus there are also attached certain smooth muscle fibers known as the *superior* and *inferior tarsal* muscles. From the convex border of each tarsus a fascia proceeds to the margin of the orbit and on each side joins the palpebral ligaments. This is the *orbitotarsal fascia*, and it, the two tarsi and the palpebral ligament form the *orbital septum*.

The mucous membrane which covers the posterior surface of the eyelids and the anterior surface of the eyeball, ordinarily known as the *conjunctiva* for convenience of description, is divided into that portion closely adhering to the tarsus which lines the under surface of the lids, named the *tarsal* or *palpebral conjunctiva*, that portion which spreads over the ocular globe, named the *bulbar conjunctiva*, and that portion which is a transitional fold connecting the two divisions just described, named the *conjunctiva of the fornix*. When the lids are coapted a closed sac is formed, named the *conjunctival cul-de-sac*, the bottom of which is this fornix. Should the conjunctiva in its entirety be dissected carefully from its attachments it would form a sheet of mucous membrane approximating in size the surface of the palm of the hand.

The conjunctiva of the lids and fornix is covered with two layers of epithelium in which superfi-

cially the cells are cylindrical, while deeper they are flattened; the conjunctiva of the scleral expanse is covered with laminated pavement epithelium, and this bulbar conjunctiva is connected with the globe by a loose connective tissue known as *episcleral tissue*. At the inner angle of the eye the scleral conjunctiva is duplicated in a crescentic manner to form the *semilunar fold* or *plica*, at the inner side of which is the small red mass known as the *caruncle*, which has the histological characteristics of skin.

The bulbar conjunctiva, its character being somewhat changed, continues over the cornea, forming its uppermost epithelial layer, beneath which is Bowman's membrane. At the periphery of the cornea a well-defined edge is formed, known as the *limbus*. The conjunctiva of the *transitional* or *retrotarsal* fold is very lax and lies in horizontal folds, as can be seen if after the lid is everted a probe is passed between the eyebrow and the turned lid, and the skin pushed down until the fold comes into view.

In the palpebral conjunctiva minute elevations, called *papillæ*, are found, over which, however, the epithelium passes evenly, so that the surface is smooth. They are larger as the upper border of the tarsus is reached. True papillæ in the form of finger-like extensions of the substantia propria with epithelium in the interstices are, according

to Parsons, found only, and then very sparsely, at the limbus. The so-called papillæ of the lid conjunctiva vary greatly in different individuals and increase markedly in pathological conditions. Certain depressions in the conjunctival surface lined with cylindrical epithelium are usually called Henle's glands, but they are the result of minute folds and are not of glandular structure.

The mucous membrane proper, *substantia propria*, lying below the epithelium, consists of adenoid connective tissue. In its meshes are many lymphocytes, often freely and regularly distributed; nodules of these lymphocytes are frequently formed, which should probably not be regarded as *true follicles*, although in this regard there is much dispute. In their pathological development they increase greatly in size and number. Plasma cells in small quantities are also present in the *substantia propria*; its deeper layers are fibrous and are less readily infiltrated with cells. In this conjunctiva and secondarily in the tarsus the lesions of trachoma find their habitat, and because their interpretation, both from the clinical and pathological standpoints, can be more readily made if the distribution and structure of the conjunctival mucous membrane and tarsus are kept in mind, this brief review of their component parts has been introduced.

DEFINITION.—Clinically, trachoma may be defined as a disease the essential nature of which

depends upon a chronic inflammatory infiltration and hypertrophy of the conjunctiva, terminating, after absorption and metamorphosis of this inflammatory material, in cicatricial changes.

From the pathologico-anatomical stand-point trachoma should be regarded as a chronic, deep and often densely produced lymphoid infiltration of the conjunctiva and tarsus, in which this lymphoid infiltration is sometimes manifested in a diffuse form and sometimes by circumscribed collections of cells which are known as "follicles."¹ This morbid process leads to destruction of the conjunctiva and as has been noted in the clinical definition to the development of scar tissue. During certain stages of the disease there may be more or less, often quite profuse, abnormal secretion from the conjunctiva, with which the spread of the infection is intimately connected.

CLINICAL VARIETIES OF TRACHOMA.—Although at one time it was customary to divide trachoma into *acute granular conjunctivitis* and *chronic granular conjunctivitis*, and although this distinction is still maintained by certain authors, and although apparently an acute trachoma has been produced experimentally, there is every reason to believe

¹ These follicles are also known as "granulations"—a term which must not be confounded with the small fleshy masses which form in wounds—and as "trachoma bodies" (an unfortunate terminology). The same name is given by some authors to the Prowazek bodies, which are described on page 77

PLATE IV



Chronic Trachoma of the Papillary Type;
Beginning Cicatrization.



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that these so-called *acute* cases represent an admixture of ordinary "glandular" lids and acute conjunctival catarrh. Indeed, an attack of acute conjunctivitis may precede the development of trachoma, or the active or acute manifestations may be due to an infection with the Morax-Axenfeld bacillus, the Koch-Weeks bacillus and even the gonococcus. This is especially true in Egypt. Moreover, trachoma is essentially a disease of exacerbation, during which the process may be so active that it simulates the primary acute disease.

CHRONIC TRACHOMA. — Chronic trachoma as originally defined is conveniently classified into several varieties.

1. *Papillary trachoma* is characterized in typical cases by an infiltration of the adenoid layer, which pushes up the thickened epithelium and by hypertrophied and congested conjunctival papillæ which make it difficult or impossible to detect the "swollen follicles" (trachoma bodies). The appearances are not unlike a chronic conjunctivitis of the non-trachomatous type, and the thickening and redness of the tissue may be so great that it somewhat resembles raw beef. To this form of the disease the term *chronic trachoma* is often specially applied. Where the follicles (trachoma bodies) can be detected lying among the greatly hypertrophied and inflamed papillæ the process is sometimes described as *diffuse* or *mixed trachoma*. (Plate IV.)

2. *Follicular trachoma* is characterized by conspicuous development of grayish-white or yellowish-red follicles in the fornices, often in rows along the upper margin of the superior tarsus, or irregularly placed in the tarsal conjunctiva, and not infrequently invading the ocular conjunctiva and even the caruncle and plica. From fancied resemblances they have been called "sage-grain" or "vesicular" granulation, and have sometimes been likened to the appearance of frog-spawn. (Plate V.)

3. *Cicatricial trachoma* is characterized by the formation of grayish-white scar lines, often intersecting the remains of old granulations, and later by diffuse scar tissue, atrophy and fibroid induration of the mucous membrane. (Plate VI.)

SYMPTOMS AND COURSE OF TRACHOMA.—In general terms the course may be divided into the stage of evolution, the stage of elaboration and the stage of cicatrization. Important to remember is the fact that the lesions may develop, especially in the upper retrotarsal folds, without antecedent inflammation, and so insidiously that their real nature is for a long time unknown to the patient, and undetected unless the lids are carefully inspected after thorough eversion. At this time there may be little or no abnormal secretion. Later the palpebral mucous membrane, often yellowish red in color, becomes unevenly rough because the tissue is filled with the growing and developing

PLATE V



Follicular Trachoma.



PLATE VI



Cicatricial Trachoma and Pannus.

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‘follicles.’ Even in this period, if the original process has not been an acutely active one, abnormal secretion may not be conspicuous.

Still later the follicular and cellular masses compress the conjunctiva and its circulation and corneal changes become manifest in the beginnings of the so-called pannus (see page 74). As time goes on vascularity increases, the follicles grow in size and increase in number, their contents may be forced out by surrounding infiltration and the hypertrophy of the so-called conjunctival papillæ becomes a conspicuous feature. During this process of fatty degeneration and softening of the follicles, or of retrogression without softening, fresh eruptions of follicles are taking place, which in turn go through the same changes which their forerunners have experienced. The conjunctiva is swollen, the papillæ greatly hypertrophied and the follicles are hard to find; indeed, they may be fused with papillæ. The mucous membrane assumes a fleshed appearance, photophobia is active, mucopurulent or purulent secretion is abundant and corneal changes are conspicuous. These various stages may last for months, but ultimately invariably trachoma results in cicatrization as the result of absorption of the contents of the follicles and proliferation of the connective tissue of the conjunctiva.

Although it is convenient to divide the course of

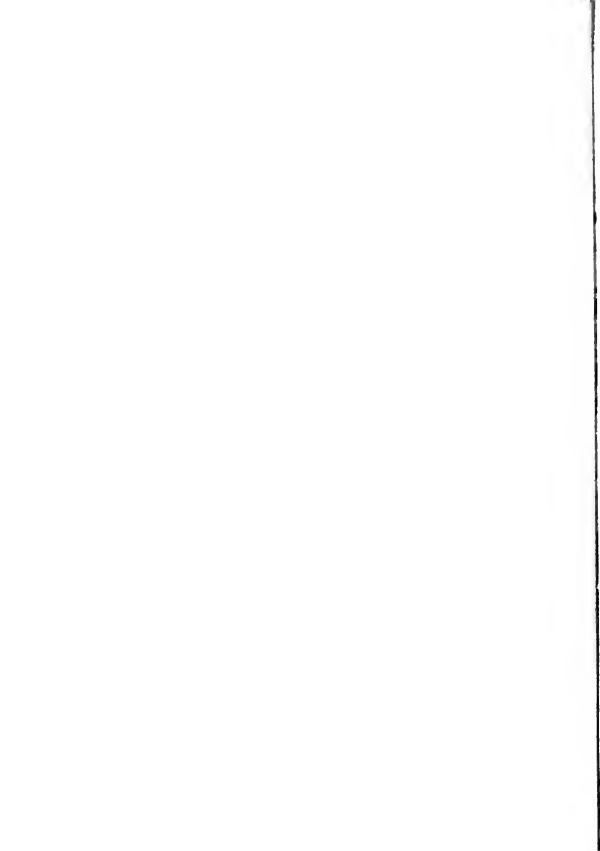
this disease into stages, it is by no means always possible to separate sharply one from the other by symptoms or manifestations peculiar to itself. Exacerbations are frequent, and these have given rise to the description of *acute trachoma*, because the irritative phenomena become intense, with scalding tears, great dread of light, corneal vascularization, ulceration and later mucopurulent discharge.

To one of the important complications of trachoma a brief reference has already been made, namely, *pannus*. Usually stated to be the result of long-standing granular lids, in its earliest stages it is often found soon after the follicular infiltration begins. It is a form of vascular keratitis, and while the rough upper lid is a predisposing factor, it is not the true cause of pannus, which is probably due to contiguity and represents a form of direct infection. Usually the upper half of the cornea becomes hazy and small vessels proceed inward from the corneal loop toward the center. At first they lie between the epithelium and Bowman's membrane, but in the later stages this membrane breaks down and the anterior layers of the substantia propria are involved. Pannus does not always begin in the upper portion of the cornea. It has been noted, for example by White, as commencing at the outer half, and in severe types the entire cornea is invaded. (Plate VII.)

PLATE VII



Typical Trachoma.



When the true corneal tissue is attacked *ulceration* occurs, and such ulcers may be extensive and deeply placed. Iritis may be a complicating circumstance. Not infrequently the corneal ulceration is followed by perforation, the cornea may become entirely opaque or it may be distorted by staphylomatous bulging. Occasionally, in place of an active ulceration, the ulcerated area is indolent in character, and there may appear just at the apex of the pannus a shallow central ulcer with a slightly turbid base, which heals and leaves a faintly opaque facet. The amount of vascularization in pannus varies considerably. Sometimes only a few vessels are present and sometimes the vessels are so thickly produced that the appearance is fleshy in character.

Other sequels of long-standing trachoma are *trichiasis*, in which the lashes are misplaced and turn inward against the eyeball, and *districhiasis*, in which incurved rows of supplementary cilia are developed from the intermarginal part of the lids. With *trichiasis entropion*, or an inversion of the lid, is often associated, and occasionally the opposite form of lid misplacement is observed, namely, *ectropion*. These deformities of the lid and its border arise because of the chronic induration and scar tissue which always ultimately develop. This tissue, firmly attached to the tarsus, which itself is softened by lymphoid infiltration, contracts and

bends the lid and its border from their normal position. As the result of the induration of the mucous membrane there may be a practical obliteration of the conjunctival sulcus, the membrane undergoing a form of drying up, to which the name *xerosis* or *xerophthalmos* is applied. Patients with advanced trachoma, especially in the cicatricial stage, often have a curiously sleepy look. They peer uncertainly through their narrow palpebral fissures, and the droop of the lid suggests in its appearance a partial ptosis. If, as is the case in the stage of increased purulent secretion, the pus glues the eyelids together the discomforts of the subjects of this disease are greatly increased.

Although for the most part trachoma is confined to the conjunctiva of the lids, and is especially pronounced in the retrotarsal folds, the bulbar conjunctiva does not always escape and the lesions of the disease may be found in many cases in the plica and the caruncles, a situation which is of diagnostic import. Furthermore, in many of its subjects inflammation of the lacrimal sac is present (dacryocystitis) and trachomatous changes may be detected in the walls of this sac and even in the mucous membrane of the nose. Recently, Gifford has called attention to the frequency with which the inner end of the canaliculus is occluded in trachomatous patients in whom the disease is of long standing.

CAUSE.—The cause of trachoma is unknown, and while there is no proof that microorganisms of the bacterial group, or blastomycetes, are etiological factors, it is the impression of Treacher Collins that the disease depends upon an organism of ultra-microscopic dimensions. If the morbid material from a trachomatous conjunctiva is transferred to another eye a disease like the one from which it came is apt to originate, and in this sense trachoma is specifically communicable; but it is a contact infection and cannot be transmitted through the air. The danger of the spread of trachoma is greatly increased if there is such morbid secretion, and therefore it is that where the hygienic surroundings are unfavorable and where the inmates of institutions, barracks, armies, camps, etc., dwell close together and are uncleanly and careless in their personal habits, using common utensils, handkerchiefs, bed-linen, etc., the facility with which the disease may spread is greatly increased.

In the discharge and in the follicle content of fresh untreated trachoma, less easily in granulated lids of long standing, small granules resembling diplococci were discovered by Halberstädter and Prowazek. Surrounded by a zone, hence called *chlamydozoa*, they occur either isolated or grouped together within the cell next to the nucleus. These "cell inclusions" are often accompanied by small bodies in the protoplasm of the cells and outside

of the cells, which are called Lindner's "initial bodies." Because the Prowazek bodies are comparatively rarely present in other conjunctival disease their detection is significant even though their nature is unknown, but their absence does not exclude trachoma. Also, they have been found in some types of ophthalmia neonatorum and in certain forms of chronic conjunctivitis, and it is said

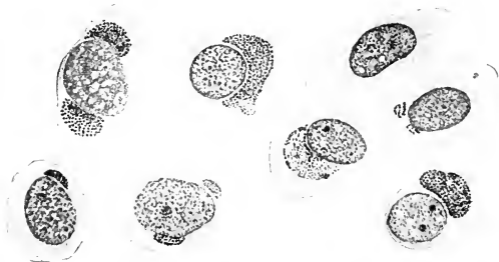


FIG. 9.—So-called trachoma bodies—epithelial inclusions. (Axenfeld.)

in their early stage in normal conjunctivæ. When first discovered they were believed to be the cause of trachoma, but later this belief was abandoned (Fig. 9).

PATHOLOGICAL HISTOLOGY.—If trachomatous tissue is examined microscopically the following cellular elements will be found in the follicles: Lymphocytes, chiefly in the peripheral zone; mononuclear leuko-

cytes, of which the greater portion of the follicles is composed; phagocytes and certain accessory elements, for instance, multinuclear cells. Beneath these follicles dilated lymph vessels are conspicuous and bloodvessels may extend into the follicles. The lymphadenoid tissue which surrounds the follicles is often densely infiltrated with leukocytes.

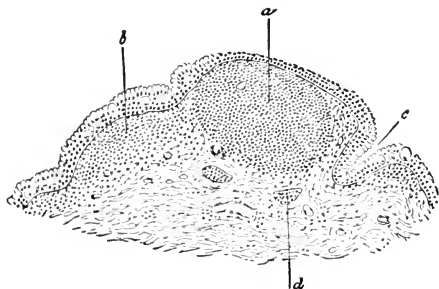


FIG. 17.—Trachoma of the retrotarsal fold: *a*, follicle; *b*, diffuse infiltration; *c*, Henle's gland with goblet cells; *d*, lymph vessel filled with leukocytes ($\times 39$). (Holden.)

This scar tissue probably depends upon a proliferation of the connective tissue of the conjunctiva (Fig. 10).

DIAGNOSIS.—When trachoma is well developed in any of the varieties which have been described there is comparatively little difficulty in making a diagnosis, and if microscopic investigation of the

tissue stained with the Giemsa material should reveal the Prowazek granules, this discovery would be a factor of importance in any case of doubt, but it would not be pathognomonic. In point of fact, up to the present time we are obliged to depend upon clinical signs in making a diagnosis.

Usually a *chronic conjunctivitis* or a chronic blennorrhœa with enlargement of the conjunctival papillæ can be readily distinguished from trachoma by the greater hypertrophy in the latter disease, and particularly by the thickening and induration of the tarsus.

Vernal conjunctivitis may be distinguished from trachoma by the flattened appearance of the granulations, often covered with a delicate film, as if brushed over with a thin layer of milk, the absence of infiltration and of pannus and by the history of recurrences at special seasons of the year. Also, eosinophiles are conspicuously present in the secretion of vernal catarrh.

Parinaud's conjunctivitis, a rare disease, has some resemblance to certain types of trachoma. It is associated with swelling of the preauricular glands, and sometimes of the lymph glands in the neck and of the parotid and submaxillary glands.

Tuberculosis of the conjunctiva, also an infrequent disease, should be distinguished from trachoma by the associated swelling of the lymph glands, and if there is any doubt, by submitting the tissue to a

microscopic and bacteriological examination. The tuberculin test, however, would not be satisfactory, as in a good many instances it would appear that the injection of tuberculin has been followed by a reaction in what would seem to be typically trachomatous tissue.

The theory that all follicles in the conjunctiva represent trachoma has often been maintained, and therefore the well-known *folliculosis of the conjunctiva*, sometimes called *follicular conjunctivitis*, and characterized by small pinkish prominences in the conjunctiva, for the most part in the retrotarsal folds, and usually arranged in parallel rows, has been regarded by some observers as a form of trachoma and called follicular trachoma.

Now, while it may not be possible in the early stages of trachoma to distinguish the so-called trachoma bodies from large lymphatic follicles, there is a distinct difference in the nature of the two conditions. In the folliculosis referred to the follicles are benign; they are smaller by more than one-half than the follicles of trachoma; they are in large measure confined to the fornices; they are never seen on the plica or the bulbar conjunctiva; pannus is not associated with them; and finally they disappear without leaving any scar tissue. And yet between these benign follicles and what Parsons calls the serious form of follicle which belongs to trachoma, border-line cases occur which

are extremely difficult to classify and of which no one has ever yet succeeded in writing a description upon which a satisfactory diagnosis could be made. Hence the importance of investigating carefully during the inspection, for example, of soldiers and recruits, every case of reddened conjunctiva, with or without the presence of follicles. If the follicles are irregularly present, and not disposed in typical parallel rows, and especially if they are deeply set and beginning induration of the tarsus is evident, the presence of trachoma becomes more than a suspicion. Moreover, even in its very earliest stages, as has recently been pointed out by Stieren and Van Kirk, in their search for trachoma among mill workers, loupe investigation of the upper portion of the cornea will not infrequently detect a very delicate ingrowth of vessels, the first beginnings of a pannus, not discoverable by naked-eye examination. This sign is an important one, and is not present if the follicles are benign.

While it is well-nigh axiomatic to state that any granular disease of the conjunctiva which results in cicatrization is trachoma, there are a few other affections of the conjunctiva which give rise to scar tissue, notably pemphigus. But in this disease, a very rare one, ulcers covered with membranes are evident, which precede the cicatrizing process, and the lesions of pemphigus elsewhere on

the body are discovered by the history or by actual observation and serve to establish the diagnosis. The scars following burns of the conjunctiva are totally unlike those of trachoma, and the history is available, and the same is true of moderate cicatrization of the conjunctiva which is occasionally seen after purulent conjunctivitis, and more frequently in connection with chronic blepharitis and its accompanying ectropion. The pannus of phlyctenular disease is usually unevenly or irregularly distributed, and is not largely confined, as in the majority of cases of trachoma, to the upper half of the cornea. (See also p. 74.) Also, the history of the two affections is totally different, and this applies to the pannus which sometimes follows trichiasis produced by conditions other than granular lids, for example, burns.

Trachoma is often spoken of as a disease of adult life. This is a mistake; severe cases are found in very young children, and this has been especially true in the investigations of McMullen, Stucky, White and other surgeons, who have had large opportunities of observing trachoma, as it occurs in the western portion of our own country, and especially in the Appalachian region.

TREATMENT.—The treatment of trachoma naturally divides itself into *medicamental*, *mechanical*, *chemical* and *operative procedures*.

As medicamental measures to check infective

secretion, the usual antiseptic and slightly astringent lotions may be employed. Those which serve the best purpose are saturated solutions of boric acid, equal parts of boric acid and physiological salt solution, bichloride of mercury (1 to 5000, 1 to 10,000) and cyanide of mercury (1 to 1500). The irrigations should be liberal, preferably with warmed solutions, and frequently repeated. To control the purulent quality of the secretion a solution of nitrate of silver (2 per cent.), painted over the diseased conjunctiva after thorough eversion of the lid, and neutralized after the white film forms by irrigations with physiological salt solution, is strongly indicated. For the same purpose argyrol (25 per cent.) and protargol (10 per cent.) are much employed. None of the silver preparations should be used for long periods of time lest argyrosis of the conjunctiva be produced, and on this account these preparations, especially argyrol and protargol, silvol and the like should not be given to the patient for home use. Recently a 0.5 per cent. oily solution of dichloramin-T has been recommended in the treatment of trachoma and has been reported as a useful agent to control abnormal secretion. It does not seem to the author to have advantages in this regard over other remedies, but it is only right that it should have a full trial before deciding as to its value in this disease.

Abnormal secretion being in control, and espe-

cially when eruptions of new granulations are associated with beginning cicatricial changes, sulphate of copper, abandoned by some practitioners, is in the judgment of the author an admirable remedy. A smooth crystal of sulphate of copper is applied to all portions of the affected palpebral conjunctiva, and the surface after a few minutes flushed with cold sterile water. An excellent application, which may substitute the copper stick, is a 5 per cent. solution of this remedy in glycerin, applied with a cotton mop, the patient several times a day instilling into the conjunctival cul-de-sac a 1 per cent. solution of the same preparation. To hasten the absorption of the follicles and to prevent xerosis of the conjunctiva, applications of boroglyceride (30 to 50 per cent.) are useful, as is also tannin and glycerin, 30 to 60 grains to the ounce (1.95 to 3.9 grams to 30 c.c.). During acute exacerbations of trachoma, so-called acute trachoma, in addition to the usual collyria, if there is iritic involvement, mydriasis is indicated. This may be secured with atropin sulphate, 4 grains (0.26 gram) to the ounce (30 c.c.), or preferably with scopolamin hydrobromate, 2 grains (0.13 gram) to the ounce (30 c.c.) of distilled water.¹ A corneal ulcer, if infected, should be cauterized with trichloroacetic acid or

¹ Of the many astringent and antiseptic applications which have been tried and recommended, only those which the author has found useful are mentioned.

carbolic acid, and in these circumstances holocain (2 per cent.) and dionin (5 per cent.) are of value.

MECHANICAL MEASURES.—From the very earliest days trachoma therapeusis has included *massage*, *scraping* and *scratching*. Massage associated with medicaments is more efficacious than simple massage, for example, by introducing a small massage glass ball beneath the lid and making counter-pressure on the cutaneous palpebral surface. As the result of long experience the late Dr. Charles H. Beard highly recommended the following procedure: After instilling one drop of adrenalin solution (1 to 2000), a tightly wound cotton mop, dipped in a solution of bichloride of mercury (1 to 250) is after eversion of the lid rubbed firmly over the affected conjunctiva for two minutes, the cotton being kept moist with renewed applications of the sublimate solution. Next, the conjunctival surface is thoroughly irrigated with a hot boric acid solution, followed by a drop of a 4 per cent. solution of cocain. This procedure should be repeated at two-day intervals, and on the alternate days the same type of massage is employed, save only that for the bichloride solution argyrol (50 per cent.) is substituted. The author has found this procedure of value, using the bichloride in the strength of 1 to 300 or 1 to 500, especially during the stage of lymphoid infiltration and decided follicular eruption, unassociated with much abnor-

mal discharge. In place of the bichloride mixture a solution of cyanide of mercury (1 to 500) may be used.

A more vigorous procedure than massage is the operation called *brossage* or *grattage*, which is performed as follows:

After the patient is anesthetized the conjunctival surface is exposed in the manner already described. The trachomatous tissue is then deeply scarified, the incisions running parallel to the margin of the lid. The surface is next rubbed with the back of the scalpel and the conjunctiva vigorously scrubbed with an ordinary tooth-brush carrying a solution of bichloride of mercury, 1 to 2000. If the palpebral fissure is very narrow, canthotomy should precede the operation. The after-treatment consists in measures to prevent adhesions between the folds of the conjunctiva and the conjunctival cul-de-sac and the daily application of a sublimate solution of the same strength as that originally used for at least a week following *grattage*. The subsequent treatment comprises the usual antiseptic lotions and applications until cure is effected.

D. H. Coover recommends that *grattage* be performed with strips of sterilized sandpaper, and D. W. White has designed an instrument for the purpose, called silica trachoma rasps, made by fixing sand on orange-wood sticks. With *brossage*, however accomplished, the author has had little experience. As the late Dr. Beard remarked, it is not an extremely bad measure, but it is far from being

as good as some others, and it has never appealed to the author.

A description of the operative procedure used by the Public Health Service has kindly been furnished by Surgeon John McMullen, and is as follows:

The eyelid is everted by means of a special forceps. Next by the use of two scalpels, one in either hand, the conjunctiva is gradually raised and the full extent of the cul-de-sac is exposed and the granulations are scarified superficially, beginning from the bottom and extending forward toward the ciliary margin. Succeeding this, in some cases, it is well to use a moderately stiff brush with bichloride solution 1 to 2000. The next step is to use fine mesh gauze sponges, and these are rubbed over the entire affected conjunctiva until the surface is smooth and the hypertrophy and granulations have been removed. This can be determined by the reappearance of the small bloodvessels to view. The operation is completed by again everting the eyelid and thoroughly washing out of the conjunctiva all blood-clots, etc., with a boric acid solution, followed by the instillation of two drops of a 20 per cent. solution of argyrol. The after-treatment consists in cleansing the eyes, every three hours, with a boric solution and the instillation of a 20 per cent. argyrol solution. This is continued for several days or until all sloughs have disappeared.

The amount of traumatism necessary depends entirely on the individual case in hand, and the operator is guided solely by the necessity of each case. If a radical operation has been performed the eyes should be examined carefully for the next twenty-four to forty-eight hours for adhesions, and these should be broken up immediately. At the end of about one week following operation, if granulations or rough surfaces are found, these should be lightly touched with a 2 per cent. solution of silver nitrate, repeated two, three, four or more times a week.

Expression.—This procedure is usually performed according to the method of the late Dr. H. Knapp, and often known as Knapp's operation:

After the patient is etherized, or a submucous injection of cocain is made, the upper lid is everted, seized at the convex border of the tarsus with a pair of fixation forceps, and drawn away from the eye so as to expose thoroughly the whole palpebrobulbar conjunctiva. If the tissue is infiltrated it may be superficially scarified, preferably with a three-bladed scarifier. One blade of the roller forceps is pushed deeply between the ocular and palpebral conjunctiva and the other is applied to the everted surface of the tarsus. The forceps is compressed with some force, drawn forward, and the infiltrated soft substance squeezed out as the cylinders roll over the surfaces of the fold held between it. This maneuver is repeated until all the morbid material has been expressed—in other words, to use Knapp's expression, until the conjunctiva has been thoroughly milked.

The lower lid is treated in the same way. During the operation the surfaces should be frequently flooded with a tepid solution of bichloride of mercury, 1 to 8000, and after the operation cold compresses may be laid on the lid for twenty-four hours. The following day the lids should be everted, and usually a delicate grayish

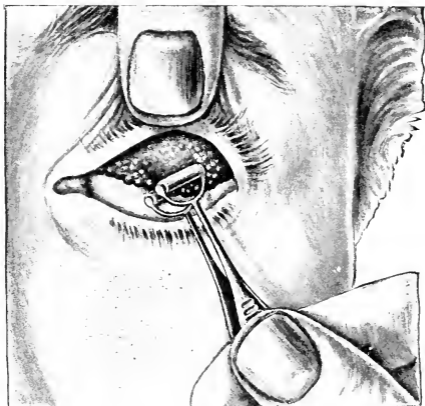


FIG. 11.—Knapp's operation for trachoma. (Hansell and Sweet.)

layer of lymph will be found covering the entire area of operation. This should be removed, the swollen mucous membrane exposed and touched in the ordinary way with a solution of nitrate of silver, 5 to 10 grains (0.324 to 0.65 gram) to the ounce (30 c.c.). Each day this treatment should be repeated until the swelling has

subsided, when the daily application of a crystal of sulphate of copper is advisable (Fig. 11).

This operation the author has employed extensively and always in suitable cases with satisfaction. It is especially valuable in cases of spawn-like granulations (follicular trachoma) and diffuse hyalin infiltration, and may be used in cicatricial trachoma associated with patches of hyaline degeneration. It is contra-indicated during an acute process, or if there is much purulent discharge. According to Weeks its effectiveness is increased if after the expression a germicide, *e. g.*, bichloride of mercury (1 to 2000), is brushed into the tissues.

In place of the Knapp roller forceps the Noyes or Prince forceps may be used, or the expressor of Kuhnt, made of two coapting perforated metal plates, which has the advantage that it causes less traction on conjunctival membrane.

The expression operation has been radically modified by D. W. White and P. C. White, in that they expose the tarsus of the upper lid by dissecting back its conjunctival covering and making a number of vertical incisions in the tarsus. Each vertical strip being rolled in the manner described, and the roller may also include the affected conjunctiva, this membrane afterward being sutured again into place. This modified roller or expression operation has the evident advantage of getting rid of tarsal lymphoid infiltration, which is not so well

or not at all accomplished in the simpler procedure. The author has had no experience with this method, which, next to certain radical measures presently to be described, its designer considers to be the most satisfactory procedure.

Chemical Measures.—This term has been applied to those procedures which include cauterization with various caustics and with the actual or thermic cautery, and may also include scarification of the conjunctiva, followed by electrolysis. None of these procedures possesses any real advantage, and severe cauterization is definitely contra-indicated. The *x*-ray treatment of trachoma, as well as its treatment by radium, bid fair for a short time to supply a new therapeutic measure in the treatment of this intractable disease. The author's own experience with the *x*-rays, while a limited one, yielded results which were indifferent, and May's observations indicate that the effect of radium is not as favorable as that of sulphate of copper. Carbon dioxide snow has been employed, and recently Tyrrell, in England, has maintained that this agent represents one of the most successful methods of treating trachoma when the follicles are over the tarsus. The author's experience with carbon dioxide is too limited to enable him to express an opinion as to its effectiveness.

Operative Measures.—In addition to the operation of expression already described in connection with the mechanical procedures, it remains to

briefly describe *curettage*; excision of the retrotarsal fold, or of a strip of the infiltrated fornix; removal of a part of the tarsus at the same time that the strip of infiltrated fornix is excised (the so-called combined excision); and extirpation of the tarsus (Kuhnt's extirpation).

1. *Curettage*.—This procedure has a very limited application, although it at one time was much practised. It consists essentially in excising individual follicles and removing their contents with a small curette, a tedious procedure, which is utterly unsuitable should there be extensive infiltration, and if practised at all, is applicable only to those conditions in which small islands of follicles exist, or have escaped some of the other procedures which have been described.

2. *Simple Excision*.—Following a suggestion of Römer, a subconjunctival injection of cocain (4 per cent.) causes the diseased transition fold of the conjunctiva to bulge forward, and makes plain a line of demarcation between the diseased area and the healthy bulbar conjunctiva. The convex margin of the tarsus is brought within the grasp of two pairs of forceps, and an incision is made in the healthy scleral conjunctiva close to the line of demarcation from the outer to the inner canthus. Müller's muscle, which has a bluish look, is usually recognized when the wound separates and the bulbar conjunctiva retracts. Next, three sutures are introduced through the margin of the bulbar conjunctiva, which is undermined. The next incision is so placed as to separate the transitional fold from the tarsus; the diseased tissue lying between these two incisions, being

seized at the inner canthus, is separated from the underlying tissue with blunt scissors and removed. Finally, the needles attached to the sutures already in place are placed through the edge of the tarsus and tied.

This operation is of some service if the trachomatous process is largely confined to the transition folds, and there are no indications of serious lymphoid infiltration of the tarsus itself. It is sometimes quite effective in checking a developing pannus, and is nearly always, if the indication as given is strictly attended to, followed by improvement. Should the lower fornix be selected for this type of incision, and Kuhnt is accustomed in large measure to restrict it to this area, the upper lid is held back and the patient is required to look upward. Next, the surgeon everts the lower lid and excises the required strip of conjunctiva, beginning usually upon the outer side. In these lower fornix excisions sutures are rarely necessary. In both instances the operation should be followed by free irrigation, the operated area dusted over with finely powdered iodoform, and the lids bandaged. This bandage may be removed at the end of a couple of days, and the usual antiseptic irrigations employed.

3. *Combined Excision*.—This operation is a mucotarsal excision whereby the affected transitional folds and the infiltrated part of the tarsus are removed. It may be performed as follows:

After free cocainization of the conjunctiva, the eye being rotated downward, the upper lid is doubly everted and held in position by means of two fixation forceps,

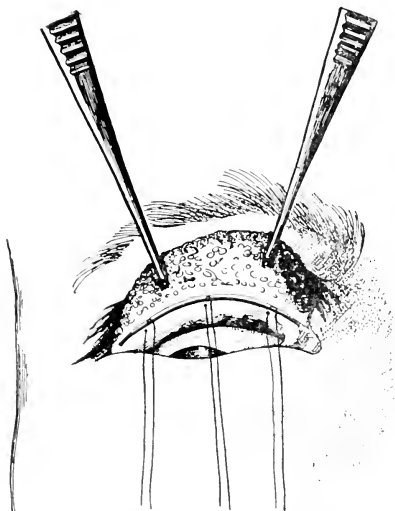


FIG. 12.—Combined excision. First stage. (Wootton, Arch. of Ophthal.)

in such a manner that the bulbar conjunctiva is drawn upward upon the surface of the tarsus. The first incision, which should penetrate the conjunctiva alone, is made transversely at the juncture of the palpebral and

bulbar conjunctiva (Fig. 12), thus separating the diseased and healthy tissue. Injury of Müller's muscle,

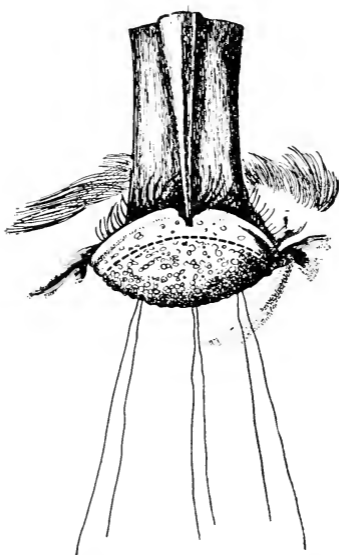


FIG. 13.—Combined excision. Second stage. (Wootton, Arch. of Ophthal.)

which lies directly beneath, must be avoided. The retracted bulbar conjunctiva is next separated from the subjacent tissue for a distance of 4 mm. Three sutures

armed with a needle at each end are inserted through the lower lid of the wound. Following this dissection the lid is allowed to take the position of single eversion, and a horn or Jaeger plate is placed beneath the skin surface of the eyelid, the margin of which is pressed firmly upon it (Fig. 13). Next an incision is made for the entire length of the lid 2.5 mm. from its inner margin and exactly parallel to it. The lateral horns of the two incisions are joined by a short vertical cut at their external and internal extremities. Thus the boundaries of the diseased conjunctiva and tarsus are fixed. The next step consists in dissecting up this area, care being taken not to injure the orbicularis or Müller's muscle. How much of the diseased tarsus shall be removed depends upon the severity of the condition and the distribution of the lesions; usually the piece removed is about 2.5 cm. long and 1 cm. broad. Hemorrhage having been checked, the operation is completed by stitching the margin of the bulbar conjunctiva to the rim of tarsus which remains, and it is important that the conjunctiva shall be united exactly to corresponding points of the tarsal cartilage. The eye is closed, and the surgeon makes gentle traction on the middle suture in a direction vertical to the lid margin. The point where the suture crosses the upper margin of the tarsal rim is grasped with toothed forceps, one blade being passed beneath the lid, which is then everted. The suture is next passed through the upper margin of the tarsal cartilage at the point designated by the teeth of the forceps. The other sutures are treated in like manner (Fig. 14). In order to avoid pressure on the cornea the sutures may be placed thus, following the method of von Blacowicz: The sutures are armed with two needles, which are passed entirely through the lid, the anterior

one transfixing the upper margin of the cartilage, the posterior one the aponeurosis muscle and skin in close

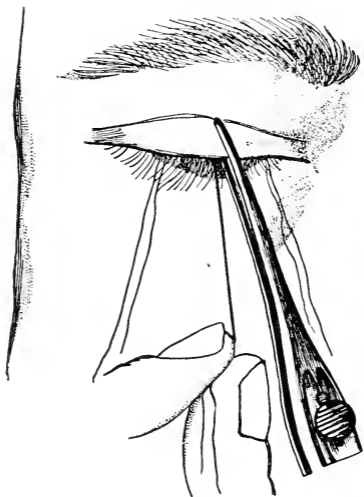


FIG. 14.—Placing of sutures. (Wootton, *Arch. of Ophthalm.*)

proximity. The sutures are tied over a roll of gauze, and may be removed on the fifth day.¹

¹ Many modifications of this operation have been described. The one recorded here is condensed and somewhat modified from H. W. Wootton's description (*Archives of Ophthalmology*, vol. xxxix). D. W. White and P. C. White have evolved an elaborate technic, fully described (*Ophthalmology*, October, 1915), and are enthusiastic advocates of the removal of the tarsal cartilage and palpebral conjunctiva in the treatment of chronic trachoma.

This operation, originally designed by Heisrath, and modified and improved by Kuhnt and other surgeons is suited to chronic trachoma with tarsal infiltration, to chronic trachoma with pannus independently of the tarsal condition, and in the so-called gelatinous trachoma of retrotarsal folds and with thickening of the tarsus.

Excision of the Tarsus.—This operation is recommended by Kuhnt in some cases of chronic trachoma with great thickening of the tarsus in the cicatricial stage. The structure is exposed through an incision running the whole length of the tarsal cartilage, 22 mm. from the free border. After exposure the tarsus is dissected from its position and detached from the levator tendon.

TREATMENT OF PANNUS.—Ordinarily pannus subsides when the various measures which have been described succeed in dissipating the granulated surface of the palpebral conjunctiva. Formerly inveterate pannus was often treated by means of the de Wecker *jequirity method*, to wit, producing a violent conjunctivitis with a 3 per cent. solution of this drug—a technic which has been abandoned. Jequiritol and jequiritol serum, introduced by Römer, have also ceased to claim attention.

Not infrequently stubborn pannus is materially benefited by *peritomy*, or more properly, *peridec-tomy*, which consists in excising a strip of the bulbar conjunctiva about 3 mm. in width, surrounding

the cornea, followed by scarification of the vessels at the limbus. In certain cases of advanced and old pannus remarkable results follow the dissection from the cornea of the opaque and vascular tissue. It has to be done with skill and care lest the cornea be perforated, and is a method of procedure recommended by the late Dr. Gruening many years ago. Should there be intense blepharospasm, and on this account dangerous compression of the cornea, or should the palpebral fissure be greatly contracted, the operation of canthoplasty is indicated. It is performed as follows:

One blade of a pair of probe-pointed scissors is introduced behind the external commissure, and the entire thickness of the tissues is divided, making the wound in the skin a little longer than that in the conjunctiva. The wound margins are next separated, and the surgeon loosens the conjunctiva at the apex of the incision and frees it from the underlying tissue. Three sutures are passed, one uniting the extremity of the conjunctival flap to the center of the skin incision, and one suture above and one below, near the angles of the wound (Fig. 15). Division of the external canthus without subsequent introduction of sutures is known as *canthotomy*.

If stenosis of the lachrymonasal duct is present, it must be rendered patulous, and chronic dacryocystitis treated by excision of the lachrymal sac.

PROGNOSIS.—Always a tedious disease and subject to relapses and exacerbations, trachoma is curable if properly managed, and the improvement

in prognosis has been evident since carefully applied mechanical measures and well-considered operative procedures have given place to, or been associated with, medicamentous applications. This is notably true in the work of Dr. John McMullen, Dr. Stucky and many others in Kentucky and the

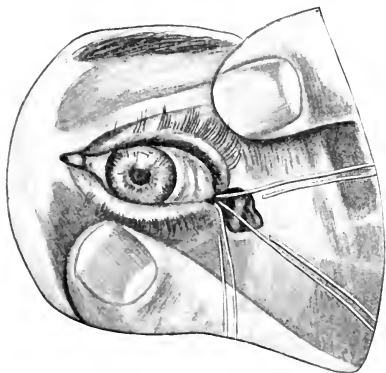


FIG. 15.—Canthoplasty. The stitches ready to be tied. (Haab.)

neighboring regions, and of the Drs. White and others in further Western States. The importance of the early detection of trachoma before decided corneal complications and pronounced lid disturbance have arisen cannot be too strongly emphasized.

PROPHYLAXIS.—In camps, cantonments and barracks there should be systematic and repeated inspection of the soldiers' eyes after thorough eversion of the lids, and all suspects promptly isolated and kept from mingling with their fellows until the conjunctivæ are entirely restored to a normal condition. It is well known that trachoma is often carried into armies from the outside; thus in trouble in this regard in the Allied Armies abroad it was largely through alien laborers that the infection was introduced. It is of paramount importance that the eyes of all recruits should be inspected before they are assigned to duty in the various camps and cantonments. This is particularly true where in our National Army recruits and drafted men come from those regions in which the prevalence of trachoma among the civil population is conspicuous (p. 64). The ease with which the infection can spread, especially if in the eyes of the carriers purulent secretion is present, is well known, and the careless use of towels, linen, handkerchiefs and common utensils cannot be too strongly condemned. Civilian visitors and workmen coming from areas where trachoma is known to exist should not escape inspection, and if any of them have eyes which are not above suspicion, he or she should be forbidden to enter the military zone.

ACUTE CONJUNCTIVITIS.

A mild variety of this affection, known usually as *simple catarrhal conjunctivitis*, in which only a moderate amount of mucopurulent secretion, containing generally only the ordinary pus-producing organisms, gathers, and which is contagious but not actively so, is readily managed. The eyes should be frequently irrigated with a saturated boric acid solution and the conjunctiva of the everted lid brushed with a 1 per cent. solution of nitrate of silver, or a 25 per cent. solution of argyrol should be dropped into the conjunctival sac several times a day. This suffices to dissipate the affection in a few days.

A more active manifestation of this disease, which on account of certain characteristic features may be regarded as a distinct affection, is *acute contagious conjunctivitis*, commonly known as "pink eye." In addition to marked edema of the lids, very free purulent secretion, often gathered into long strings, and subconjunctival hemorrhages are evident. In typical cases the affection is caused by the Koch-Weeks bacillus; but an almost exactly similar condition is due to the pneumococcus. Intensely contagious, this infection spreads rapidly from one person to another, and where individuals are closely associated, as in schools, camps, etc., can speedily develop into an epidemic. The duration of the disease is usually from six to ten

days. The prognosis is entirely favorable. (See Plate VIII.)

The treatment does not differ from that already detailed, except that it should be more vigorous. In addition to the usual collyria, bichloride of mercury may be tried, 1 to 10,000. A mixture of sulphate of zinc, 1 grain (0.13 gram) to the ounce of sterile water (30 c.c.), is valuable; iced compresses afford relief at the height of the affection. Argyrol is commonly prescribed, but it should not be too long continued. Brushing the everted lids with a 1 per cent. solution of nitrate of silver is useful, the excess to be neutralized with physiological salt solution.

GONORRHEAL CONJUNCTIVITIS OF ADULTS.

This can usually be traced to its source of contagion from an acute gonorrhoea or a gleet, by contact with soiled fingers or linen or from an eye affected with this type of conjunctivitis, and like urethral gonorrhoea is due to the activities of the gonococcus, which is readily detected in the pus after staining smears with the ordinary reagents, for example, methylene blue. (See Plate VIII.) Usually appearing within twenty-four to forty-eight hours after inoculation, its symptoms develop with great activity; rapid and tense edema of the lids; thick, greenish-yellow pus; chemosis of the bulbar conjunctiva, and unless the violence of the inflammation is quickly subdued, haziness of the cornea; ulceration

PLATE VIII



Fig. I.—Discharge from right eye in a case of purulent conjunctivitis; gonococci numerous in cells (Stephenson).

Fig. II.—Bacillus of Weeks in pure culture (from a photograph) (Weeks).

Fig. III.—Conjunctival secretion from acute contagious conjunctivitis; polynuclear leukocytes with the bacillus of Weeks; *P*, phagocyte containing bacillus of Weeks; immers. $\frac{1}{2}$, oc. III (Morax).

Fig. IV.—Secretion from a case of conjunctivitis, showing pneumococci; immers. $\frac{1}{2}$, oc. III (Morax).

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of this membrane, which may quickly be perforated; prolapse of the iris with all its evil consequences may occur. Loss of the eye from the formation of staphyloma, or sloughing of the entire cornea and phthisis bulbi, is always imminent. The prognosis is grave, and fully developed gonorrhœal ophthalmia almost always eventuates in corneal ulceration.

The following method of treatment the author has found efficacious in a very large experience in the wards of the Philadelphia General Hospital: (1) The constant application of iced compresses, which in the earlier stages should be continuous, but as the inflammatory process subsides may be employed for periods of twenty minutes to half an hour every three or four hours. (2) The conjunctival sac should be irrigated with sufficient frequency to wash away the rapidly accumulating pus, using either the bichloride of mercury, 1 to 8000, or cyanide of mercury, 1 to 5000, or a saturated solution of boric acid. (3) Into the conjunctival sac a 25 per cent. solution of argyrol should be instilled with sufficient frequency to keep the inflamed mucous membrane immersed in the fluid. The argyrol has absolutely no germicidal effect, but it is detergent, sinks to the bottom of the cul-de-sac, and floats to the surface pus and mucus, which can thus be readily removed. In place of argyrol, protargol is advised, in 10 per cent. solu-

tion, by many surgeons, but in the experience of the author neither the argyrol nor the protargol is usually sufficient, and certainly in addition to the argyrol once a day the lid should be everted and painted with a 2 per cent. solution of nitrate of silver, the excess to be neutralized with physiological salt solution until the white film which accumulates after the silver application has been thoroughly washed away. The lids are then returned into place and anointed with vaselin, some of which is permitted to enter the sac. The cornea must be watched with great care for signs of haziness or ulceration, and practically always it is necessary to keep the iris under the influence of a mydriatic, for example, a drop of a 1 per cent. solution of sulphate of atropin, two or three times a day. If there is great chemosis of the bulbar conjunctiva, and therefore great danger of corneal sloughing, incisions of this hard rim relieve the pressure. Occasionally in stubborn cases Kalt's method of using copiously, a pint at a time in continuous irrigation, a solution of permanganate of potassium, 1 to 2000 to 5000, once a day, acts most favorably. Naturally, the vigor of these applications must be lessened as the inflammatory symptoms subside.

The spread of a corneal ulcer may sometimes be checked by touching it with trichloroacetic acid, or liquid carbolic acid, care being taken to touch

only the sloughing area. If one eye alone is affected, the other eye should be carefully protected by covering it with a Buller's shield, made from a watch crystal carefully put in place with strips of plaster or gauze and collodion (Fig. 16). Much of the suc-

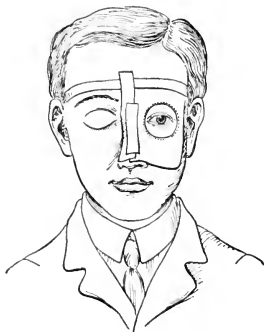


FIG. 16.—Application of Buller's shield. (de Schweinitz.)

cess of the treatment of this disease consists in constant attention, and a special nurse or a skilled orderly should be detailed for this purpose. Great care must be taken to destroy all cotton, cloths, etc., which come in contact with the inflamed eye. The patient should be isolated, and have his own set of treatment bottles, etc.

DIPLOBACILLUS CONJUNCTIVITIS.

This is a troublesome form of conjunctivitis, usually subacute in character, but sometimes so active that it assumes acute proportions. In the subacute types there is generally a moderate discharge, an irritability of the conjunctiva, and frequently a soreness of the commissural angles, so that the disease is sometimes called angular conjunctivitis. Many of the types of so-called subacute conjunctivitis, and even chronic conjunctivitis, are of this character. The diplobacillus of Morax and Axenfeld is most readily detected by smears, examined under the microscope stained for the bacteriological content. In these cases the ordinary collyria are of little value, and nitrate of silver is not of much use; in fact, of practically no use. The specific is zinc, and the lids should be everted once a day and touched with a 1 per cent. solution of sulphate of zinc, the excess being flushed off with boric acid, and the patient given a collyrium of sulphate of zinc, 2 grains to the ounce, to be used frequently. This is practically a specific. Other preparations of zinc are equally valuable, especially the soziodolate (1 or 2 per cent.).

OCULAR PHENOMENA OF "GASSING" (GAS CONJUNCTIVITIS).

In the earlier periods of the war, drift- or cloud-gas attacks were delivered from compressed cylinders and carried over by means of pipes, the gas being composed of chlorin mixed with phosgene. This type of gas caused, in addition to great irritation of the respiratory tract, a smarting and pricking sensation of the eyes, followed by blepharospasm, photophobia, intense chemosis of the conjunctiva and well-defined and often violent conjunctivitis. In the majority of instances severe corneal lesions did not arise, but if the cornea was examined carefully by means of a loupe, small infiltrations were noted, especially in the periphery, and a keratitis characterized by vesicle formation has been observed, as has been described by Major George Derby and other surgeons. It is probable that the corneal changes were more frequent than the records seem to show and were not detected, owing to insufficiency of investigation. Occasionally eyes were lost as the result of severe and purulent types of keratitis, but this was a very rare complication.

At the present time drift-gas attacks have been abandoned and their place taken by shell gas, the projectile being filled with liquid which is converted into gas by the explosion of the shell. Systematic writers have classified shell gas according to the effects into lachrymal or tear gas, of which benzyl bromide is the type; eye and lung irritants, for

example, chlorin; lung irritants and asphyxiants, for instance, phosgene; eye and skin irritants characteristic of mustard gas.

Lachrymal gas produces excessive epiphora, photophobia and palpebral spasm. Its ocular effects are evanescent and serious results from the ophthalmic stand-point are rare. Although it has been stated that phosgene has little effect on the eyes, it has also been noticed that this agent may be responsible for a mucopurulent conjunctivitis, and sometimes phosgene and mustard gas appear to have been combined.

Mustard gas produces extensive burns of the skin, particularly along the inner sides of the thighs, on the genitalia and where the skin is thin and moist. A large percentage of soldiers subjected to mustard-gas attacks present ocular lesions. The lids are swollen and may be covered with blisters or bullæ; photophobia and lacrimation are intense and the conjunctival lesions vary from moderate hyperemia to pronounced injection, extensive white chemosis and edema, the affected conjunctiva somewhat resembling a mucous membrane which has been brushed with a strong solution of nitrate of silver. In the majority of these cases there is corneal involvement, roughening of the epithelium and sometimes well-marked band-like opacity of the cornea. Occasionally there are severe ulcers and even hypopyon-keratitis, but these dire results

are comparatively rare. Occasionally temporary loss of vision has been noted. Whether this is due to the violence of the local reaction or to intra-ocular changes has not been satisfactorily determined. Some French observers have described a form of retinitis.

Many of the soldiers with mustard-gas conjunctivitis are able to return to their Units at the expiration of three or four weeks, ultimate recovery being the rule. Occasionally, however, the convalescence is much prolonged; a few eyes have been totally lost. To give some idea of the frequency of the corneal complications, it may be stated that in an analysis made by Teulières of 1500 men who had been gassed, there were only 23 with severe eye lesions, 3 corneal ulcers and 1 panophthalmitis. Sometimes nebulous corneæ result. Occasionally the leukomas are marginal, the central vision not being disturbed.

The most satisfactory treatment consists in a lotion of a 1 per cent. solution of sodium bicarbonate. Liquid albolene or paraffin is employed with benefit, especially if later irrigation with an ordinary saline solution is used. Apparently an ordinary oil, for example, castor oil, does not act as satisfactorily as the albolene or paraffin. Dionin has been recommended for the corneal complications, but there is much difference of opinion with reference to its efficiency. As the pupils are apt

to be contracted and ciliary irritation is frequent, atropin is advisable. The eyes should be protected during the earlier stages with a shade or dark glasses, but the patients should be encouraged to be up and about as soon as possible lest they pass into a stage characterized by photophobia and asthenopia, when really there are no local ocular lesions remaining to account for them.

EXAMINATION OF MALINGERERS.

BY WALTER R. PARKER, M.D.,

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MALINGERERS who wish to evade military service through feigning faulty visual acuity may be divided into three classes as follows:

“A”—Those who claim total loss of vision in one eye.

“B”—Those who claim partial loss of vision in one or both eyes.

“C”—Those who claim total blindness in both eyes.

Representatives of any group may have a normal acuity of vision or may exaggerate a defect actually present.

The visual requirement for recruits being for unlimited military service 20/100 in each eye correctable to 20/40 in one eye and for limited military service 20/200 in each eye correctable to 20/40 in one eye, it is only necessary to prove that at least this amount is present, leaving the deter-

mination of the actual acuity of vision for future examinations.

In testing for malingering the medical examiner should bear in mind that detection is more likely to result when the man is allowed to believe that his case is regarded from the first as genuine and that his story is not discredited. There is something indefinable in the bearing of the malingerer which experience alone can detect. He may be self-assertive and overconfident; he may be hesitating and evasive. Careful observation should be made of his conduct and every movement noted. The nature of the man's answer should be taken into account and considered in the light of the kind of reply that is given when a genuine refraction case is being dealt with.

EQUIPMENT.

1. Trial frame, 1 blank, 1 green glass, 1 red glass. Spherical lens, +16, +6, +3, +0.25, -3, -2, -1, -0.25.
2. Two 10-degree prisms.
3. Ophthalmoscope. Electric.
4. Condensing lens.
5. One loupe.
6. Snellen's malingering test glass (FRIEND) in red and green letters on glass.
7. Special test card. Instead of the single top letter representing 20/200, the scale should be rearranged so that it begins with the top letter

20/100 followed by two 20/70, three 20/50, etc., in imitation of the standard types. Thus the man who has been coached to read but four lines and reads them has passed the standard without being aware that he has committed himself.

8. Test card, with letters reversed for use in mirror.

9. Test cards, one line of type on each card and three cards for each size of letters. These cards are to be exposed to view at a distance of twenty feet, one card at a time. Thus the recruits do not know to which line the letter corresponds on the regular test card.

10. One stereoscope and cards.

11. Retinoscope, electric and reflecting mirror.

12. Drugs.

Euphthalmin hydrochlorate (disks if possible).

Homatropin (disks if possible).

Cocain hydrochlorate (tabloid if possible).

Eserine salicylate (disks if possible).

METHODS OF EXAMINATION.—*CLASS "A."*—(Total loss of vision in one eye.)

(a) A prism, base downward, is placed before the admittedly sound eye while the man looks at a distant point of light or candle flame. If he sees two lights, binocular vision is proved. The examiner may vary the test by placing the prism before the "blind" eye, either base up or base down.

(b) A prism of 10 degrees with base outward is placed before the "blind" eye. If there is any sight in this eye, double vision will be produced and the eye will be seen to move inward to correct it and fuse the two images.

(c) The "blind" eye is covered. A prism of 10 degrees with the apex up is placed before the sound eye in such a position that its edge lies horizontally across the center of the pupil. This produces monocular diplopia. The prism is then moved upward so as to be completely in front of the sound eye, and at the same time the "blind" eye uncovered. If diplopia is produced or admitted, there is sight in the "blind" eye.

(d) *Test with Colored Glasses and Letters.*—This consists in directing the individual to read a row of red and green letters through a red and green glass. The red letters will be invisible to the eye that has the green glass before it and *vice versa*, but if all the letters are correctly read irrespective of their color, there must be sight in the "blind" eye. Further, the smallest letters correspond with the 20/40 test letters and if read at twenty feet indicate vision up to standard. To determine this, reverse the glasses and direct the letters to be read. As these letters are seen by transmitted light, the proper illumination back of the chart must be observed.

(e) *Tests with Trial Glasses.*—A high plus glass is placed before the sound eye and a low plus or minus before the “blind” eye. If the distant type is read, the vision in the “blind” eye is good. Or a plus 6 diopter lens is placed before the sound eye and the test type placed very close to the eyes and the patient allowed to read. Gradually increase the distance until the card is beyond the focus of the sound eye. If the patient continues to read, he is seeing with the alleged “blind” eye.

(f) *The Stereoscopic Test.*—This may be made with the ordinary stereoscope, the printed matter so arranged that certain portions of it are not present before one or the other eye. If the patient reads consecutively, he is reading with both eyes. This test may be greatly varied by using different symbols or figures, only a portion of which is present on each side so that it requires binocular vision to see the complete figure.

(g) The action of the pupil must be carefully tested, there usually being no movement to light stimulation when the eye is blind.

If the examiner is not satisfied the following examinations should be made:

Oblique Examination.—A careful examination of the cornea should be made with the aid of a condensing lens and a loupe.

Ophthalmoscopic Examination.—A searching examination with the ophthalmoscope should be made

together with an estimation of the refractive error. The pupil should be dilated if necessary.

CLASS "B."—Partial loss of vision in one or both eyes.

The most common manifestation of malingering takes the form of a statement that one eye is imperfect, and men pleading this disability may be divided into two classes:

(a) Those who pretend to have an optical defect.

(b) Those who know they have an optical defect and exaggerate its effect.

No hard-and-fast tests can be prescribed for the detection of these cases. Much depends on the alertness and ingenuity of the medical examiner.

The tests with prisms are not applicable here, for there is not pretended blindness in one eye, but simply an alleged diminution of the visual acuity.

METHODS OF EXAMINATION.—CLASS "B."

(a) Special test card. (See equipment No. 7.)

(b) Single line test cards. (See equipment No. 8.)

(c) Trial frame test. Place a trial frame upon the man's face and put before the sound eye a high convex lens (+16D), and before the blind eye a plain or weak lens (0.25) which will not interfere with vision. If letters placed at distance of twenty feet are read, the fraud is at once exposed.

(d) *Mirror Tests with Special Test Cards.* (See equipment No. 7.)—Test cards are used which are identical, except one has the letters reversed. The recruit is directed to read the letters on the chart across the room, and then in a mirror beside it, which reflects letters that are placed over his head. The letters seen in the mirror are located double the distance of the direct letters from the man being examined. The malingerer is apt to read in the mirror the line which he read on the first card, showing that his vision is twice as good as he pretends.

(e) Oblique examination with condensing lens and loupe.

(f) *Ophthalmoscopic Examination.*—It is probable that the malingerer will resist the ophthalmoscopic examination by frequent winking or rolling of the eyes. In this event, it is best to caution the man that a report of his vision must be made, and then to postpone further examination until after the next few recruits have been examined.

Estimate the refractive error with the use of the ophthalmoscope. If no error of marked degree exists and the media and fundi are normal, the relation between the alleged vision and the refractive condition furnishes an important clue. If the error is about $+4.00$ or -2.00 the visual acuity could be about $20/100$, but when the defect cannot be accounted for objectively and the vision is

brought from 20/100 to 20/50 or 20/30 by means of a low plus or minus glass, the man is malingering.

(g) Retinoscopy.

CLASS "C".—TOTAL BLINDNESS IN BOTH EYES.

—Total blindness in both eyes is rarely claimed. It is almost impossible for a man to deceive those who see him daily, and there will usually be found some acquaintance who is ready to testify against him.

Every case of total blindness, the cause of which cannot be determined, should be regarded with suspicion.

If an applicant is actually blind in both eyes and there exists no adhesion of the iris, the pupils are as a rule well dilated and react slightly, if at all, to light stimulation.

A test pretending to discover the applicant's ability to determine direction may be made in the hope of catching him off his guard. The examiner may go to one side of the room and ask the patient to approach him. In his way may be placed some articles of furniture, though care must be taken that the patient may not injure himself. Observation should be made as to whether or not the patient avoids the objects so placed.

A patient who complains of sudden total loss of vision must assume the attitude and gait of a blind man, walking stiffly and hesitatingly, with hands

outstretched, face impassive, expression dull; eyes turned upward, eyelids immovable even when flashes of light or objects are quickly brought toward his eyes. The occlusion bandage may be applied for a day to ascertain if the patient can maintain the role of the blind patient as well as when both eyes are uncovered.

Schmidt-Rimpler suggests that the patient be told to look at his own hand, which he holds a short distance from his eyes. A blind man will easily succeed in casting his eyes in the direction of his own hand while a pretender may affect to look in a different direction, believing that he is thereby deceiving the examiner. The examiner may use the prism test described on p. 116 (*b*).

OCCUPATION.—The man's occupation in civil life may have been such that it could not have been followed without more vision than he claims.

In the absence of ocular defects, continuous and persistent blepharospasm, the use of colored glasses, eye shades or eye bandages should be regarded with suspicion.

DIPLOPIA.—Cases of malingering are occasionally met with in which the man complains that he sees double. These must be investigated with the application of the ordinary tests as if they were genuine, with every precaution taken to guard against a serious nervous lesion being overlooked.

COJNUNCTIVITIS.—Inflammation of the lids is sometimes produced by introducing irritating substances in the conjunctival sac, ipecacuanha powder, soap, particles of sand or other foreign matter being used for such purposes.

The characteristics of this form of conjunctivitis are its sudden onset, usually in one eye alone, the marked irritation and swelling of the lower conjunctival sac, with a moderate amount of secretion. Sometimes the lids have an erysipelatous appearance, and great difficulty is experienced in opening them. Corneal ulcers have been observed.

DISEASES OF EYE AND ADNEXA.¹

Abscess of lid	Dacryoadenitis
Amaurosis	Dacryocystitis
Amblyopia	Detachment of choroid
exanopsia	of retina
hysterical	Ectropion
nocturnal	Entropion
toxic	Epiphora
Ankyloblepharon	Exophthalmos
Aphakia	Fistula of lacrimal sac
Astigmatism	Glaucoma
Blepharitis	acute
Blepharospasm	chronic
Cataract	secondary
Cellulitis of lids	Hemianopsia
Chalazion	Hemorrhage into retina
Choked disk	subconjunctival
Choroidal tumor	into vitreous
Choroiditis	Herpes zoster ophthalmicus
suppurating choroiditis	Hordeolum
Color-blindness	Hyperemia of conjunctiva
Conical cornea	Hyphemia
Conjunctivitis	Hypopyon
acute catarrhal	Iridocyclitis
chemical	Iritis
chronic	acute
follicular	chronic
granular (trachoma)	syphilitic
phlyctenular	Keratitis
purulent	herpetic
traumatic	non-ulcerative
vernal	parenchymatous
Cyclitis	phlyctenular

¹ Lists furnished for the Surgeon-General's Office by the Section of Ophthalmology.

Keratoiritis	Proptosis
Keratomalacia	Pterygium
Leukoma	Ptosis
adherens	Retinitis
Lacrimal obstruction	albuminurica
Lagophthalmos	diabetic
Myopia	hemorrhagic
Neuritis (optic)	syphilitic
Neuroretinitis	Retrobulbar neuritis
albuminurica	Scleritis
Nystagmus	Snow-blindness
Obstruction of retinal arteries	Staphyloma of cornea
Opacity of vitreous	Symblepharon
Ophthalmoplegia	Sympathetic ophthalmitis
externa	Synechia
interna	Thrombosis of retinal veins
Orbital cellulitis	Ulcer of cornea
Panophthalmitis	Uveitis
Paralysis of ocular muscle	Xerosis
Presbyopia	

EYE INJURIES.

Burns of conjunctiva	Penetrating wounds of
Concussion of eye	cornea
Contusion of eye	lens
Ecchymoses of conjunctiva	lids
of lids	orbit
Foreign bodies in	sclera
anterior chamber	Perforating wounds of
choroid	cornea
conjunctiva	globe
cornea	orbit
iris	Prolapse of ciliary body
lens	of iris
lids	Ruptures of choroid and retina
orbit	of cornea
sclera	of globe
vitreous	Tears of lids
Injury to optic nerve	multiple
Iridodialysis	simple
Penetrating wounds of	Traumatic cataract
ciliary body	

EYE OPERATIONS.

- Advancement of eye muscle
- Blepharoplasty
- Canthoplasty
- Canthotomy
- Cataract extraction
- Chalazion operation
- Conjunctival keratoplasty
- Dilation of lacrimal duct
- Discision for cataract
- Ectropion operation
- Entropion operation
- Enucleation, simple
 - with implantation
- Epilation
- Evisceration
- Excision of tarsus
- Exenteration
- Extirpation of lacrimal sac
- Foreign bodies, removal from
 - anterior chamber
 - conjunctiva
 - cornea
 - lens
 - lids
 - magnet, extraction of
- Foreign bodies, removal from
 - orbit
 - sciera
 - vitreous
- Incision of abscess
 - of lacrimal sac
- Iridectomy
- Iridotomy
- Krönlein's operation
- Paracentesis of cornea
- Plastic on lids
- Probing of lacrimal duct
- Pterygium
- Ptosis operation
- Saemisch operation
- Sclerocorneal trephining
- Sclerotomy
- Staphyloma operation
- Suction for traumatic cataract
- Symblepharon operation
- Tarsorrhaphy
- Tenotomy of eye muscle
- Trachoma, expression for
- Trichiasis operation



INDEX.

A

AMBLYOPIA, hysterical	51
nocturnal	51
Anatomy of eyelids	66 to 69
Army lists of eye diseases and operations	123

B

BURNS of lids	12
treatment of	14

C

CATARACT, traumatic	37 to 40
treatment of	39 to 40
Choked disk	49
Ciliary body prolapse	36
Commotio retinae	10
Concussion of eyeball	37
treatment of	38
Conjunctival keratoplasty	31
description of	32 to 37
Conjunctivitis	103
acute simple (catarrhal)	103
treatment of	104
chronic (diplobacillus)	108
treatment of	108
follicular	81
gas	109
gonorrhœal	104
treatment of	105 to 107
Parinaud's	80
tubercular	80
vernal	80

Contusion of eyeball	10
treatment of	11
hypotony	11
Corneal abrasions	14
treatment of	14
ulcers	43
treatment of	43 to 44
Cranial injuries	48 to 51

D

DISTICHIASIS	75
------------------------	----

E

ECTROPION	75
Entropion	75
Enucleation	16 to 18
indication for	59
with implantations	16
Evisceration	20 to 21
indication for	60
Eye, penetrating wounds of	15
Eyelids, wounds of	45

F

FLUORESCEIN solution	15
Foreign bodies in anterior chamber	15 to 27
in cornea	12
treatment of	12 to 13
in globe	22
treatment of	22 to 23
in iris	14, 27
treatment of	14, 27
in lens	27
magnetic	22 to 29
non-magnetic	29
in orbit	41
in vitreous	22 to 29

G

GAS bacillus in orbit	41
conjunctivitis	109
Glaucoma (secondary)	37

H

HEMIANOPSIAS	50
Hemorrhage, orbit	40
retina	48
vitreous	10
Hypheemia	10
Hypotony, contusion	11

I

INCREASED intracranial pressure	49
Instruments	55 to 57
Iridocyclitis	31, 36
Iridodialysis	10
Iris (prolapse of)	32, 36
Irrigation	33, 39

K

KERATITIS (neuroparalytic)	42
--------------------------------------	----

L

LAGOPHTHALMOS	42
Lens, dislocation of	10, 38
in vitreous	38
Lid wounds	12, 45 to 46

M

MAGNETS	23 to 27
Malingers	113
blindness feigned by	120
classes of	113
colored glasses and letter for	116
conjunctivitis in	121
diplopia in	121
equipment for examination	114
examinations of	113
methods of examination for	115 to 121
mirror tests	119
occupation test	121
ophthalmoscope tests	119
prism tests	119
stereoscope test	115
trial glasses test	115
Meningitis	49, 59

N

NOSOPHEN ointment 14

O

OPTIC neuritis 49, 50
 Orbit, injudicious exploration of 44
 penetrating wounds of 40
 perforating wounds of 40
 Orbital cellulitis 20, 21, 41

P

PANNUS 74
 treatment of 99, 100
 Panophthalmitis 20
 Paralysis of ocular molar nerves 50
 Penetrating wounds of eye 15 to 37
 of orbit 40
 Perforating wounds of eye 15 to 37
 of orbit 40
 Prophylaxis (against eye injuries) 46, 47
 Proptosis 42
 Prosthesis, cartilage 18
 glass 16
 metallic 16
 Psychoneuroses 51

R

REFRACTION 51
 Retinal edema 48
 separation 30
 Retinitis pigmentosa 51
 Rupture of choroid 10
 of globe 10, 11
 of retina 10

S

SCOTOMAS 50
 Suction 39
 Sympathetic ophthalmitis 36

T

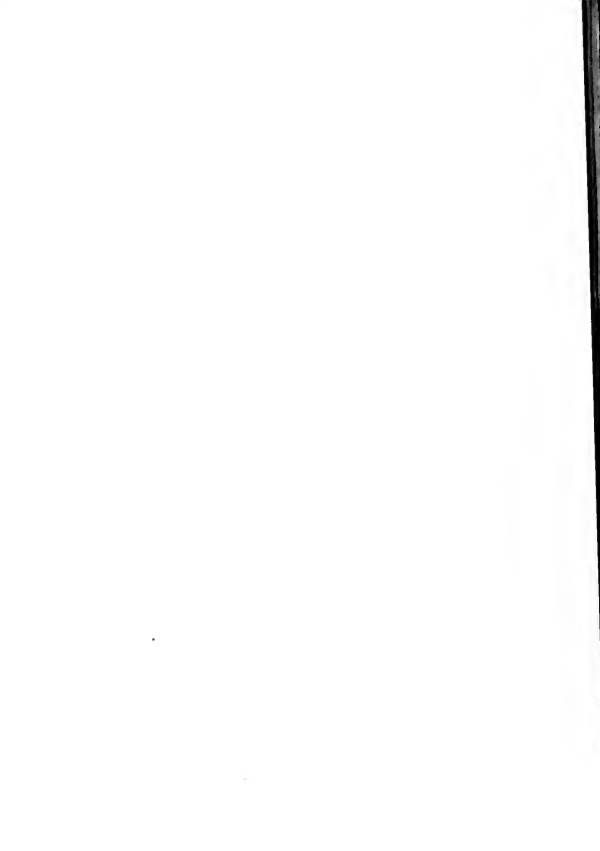
TRACHOMA	61
acute	74
brossage in	87
causes of	76 to 78
chemical treatment of	76
chronic	71
cicatricial	72
curettage for	93
definition of	69
diagnosis of	79
distribution of	62 to 66
excision for	93
combined	94 to 99
follicular	72
grattage in	87
papillary	71
pathology of	78
predispositions to	65
prognosis of	100, 101
prophylaxis	102
symptoms and course of	72 to 76
treatment of	83
mechanical	86 to 92
Trench nephritis	42
Trichiasis	75

W

WHITE'S ointment	14
----------------------------	----

X

X-RAY localization	23, 41
------------------------------	--------



LOAN PERIOD 1	2	3
HOME USE		

4	5	6
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ALL BOOKS MAY BE RECALLED AND
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